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SPILL RESPONSE PLAN

Comox Valley Regional District

Courtenay Pump Station

May 2017

CANADA'S BEST MANAGED COMPANIES Platinum member

ASSOCIATED ENGINEERING

QUALITY MANAGEMENT SIGN-OFF

Signature

Date May 26, 2017 #18-17-026

Table of Contents

1 Background

1.1 INTRODUCTION AND PURPOSE

This document is a Spill Response Plan for the Comox Valley Regional District's (CVRD's) force mains that convey wastewater from the Courtenay Pump Station and the Jane Street Pump Station to the Comox Valley Water Pollution Control Centre (CVWPCC). The purpose of this document (and the related Replacement Materials) is to provide the CVRD with the necessary tools to respond to a failure in the wastewater force mains, whether it is a minor leak, or a significant break.

1.2 HOW TO USE THIS DOCUMENT

In the event of a spill-related emergency (i.e., a leak or break in the wastewater force main), go straight to Section 4 and focus on the green text.

All CVRD personnel that may be involved with responding to a wastewater force main spill, from decision makers to field personnel, should become familiar with this document and the related Replacement Materials. In addition, CVRD personnel should strive to review the document at least annually, and update its contents as necessary (i.e., Inventory of Replacement Materials, contact information for notifications and contractors). Appendix A contains information on training, including the training approach and the training presentation and materials.

Note that this document does not cover the outfall gravity/force main, which runs from the CVWPCC to the marine outfall at Cape Lazo and conveys treated effluent (versus raw wastewater). That being said, some of the general approaches described here could be useful when responding to a failure in the outfall gravity/force main.

1.3 TECHNICAL SUMMARY

The force main that conveys wastewater from the Courtenay Pump Station and the Jane Street Pump Station to the CVWPCC was installed in the early 80's. The piping system is comprised of two types of piping.

The first type of piping under the scope of this Spill Response Plan is known today as Prestressed Concrete Cylinder Pipe (PCCP). PCCP was originally covered by the American Water Works Association (AWWA) C301 Standard, but is now manufactured under the AWWA C304 Standard. PCCP contains a steel cylinder that functions as a watertight conveyance for liquids, while high-strength steel wire wrapped under tension around the pipe provides strength. An internal concrete lining and external mortar coating provide corrosion protection to the steel components. When installed, the pipe was sold under the name of "Hyprescon". PCCP piping was installed in a 750-mm diameter size from the Courtenay Pump Station to the point where the piping meets the piping from the Jane Street Pump Station; see blue line in Figure 1-1.

Figure 1-1
Key Plan A

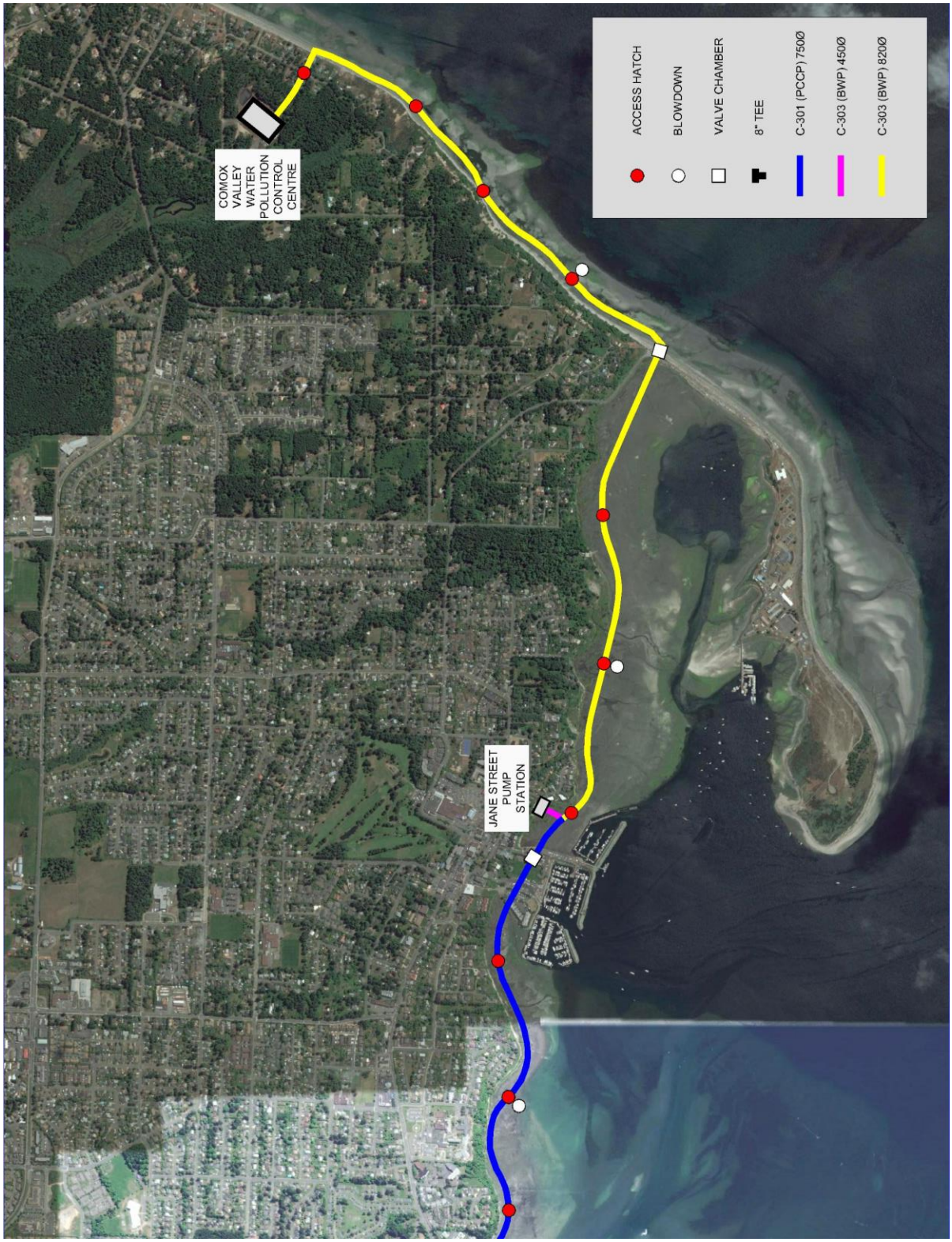


Figure 1-2
Key Plan B

The second type of piping under the scope of this Spill Response Plan is known today as Bar-Wrapped Pipe (BWP) or "Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type", as the current version of the AWWA Standard C303 calls it ("bar-wrapped" has replaced the original "pre-tensioned" descriptor). BWP contains a steel cylinder that functions as a watertight conveyance for liquids, while steel reinforcing bars wrapped under tension around the cylinder provide strength. An internal concrete lining and external mortar coating provide corrosion protection to the steel components. Like the above PCCP, the pipe was sold under the Hyprescon name. Hyprescon was purchased by Forterra Drainage Pipe & Products (Forterra), a Texas-based company in 2007; that being said, there are other manufacturers of PCCP and BWP. BWP piping was installed in a 450-mm diameter size from the Jane Street Pump Station to the point where it meets the 750 mm diameter PCCP, and BWP was also installed in an 820-mm diameter size from the meeting point (where the 450 mm diameter BWP meets the 750 mm diameter PCCP) all the way to the CVWPCC (see Figure 1-2 above).

The following table summarizes the types of discussed above pipe and their key dimensions.

Table 1-1
CVRD Piping from Courtenay and Jane Street Pump Stations to the CVWPCC, and from the CVWPCC to the Cape Lazo Outfall

Pipe Type	Nominal Diameter (mm)	Pipe ID (mm)	Spigot OD / Bell ID (mm)
BWP	450	457	514
C303	820*	820	870
PCCP	750	762	870
C301	900**	914	1041
* Shown as 860 in the AESL layout/profile drawings.			
** Not in the scope of the 2017 AE Spill Response Plan.			
ID - Inner Diameter; OD = Outer Diameter.			

As can be seen in the above table, the bell inner diameter (ID) and the spigot outer diameter (OD) are the same for the 820-mm diameter BWP and the 750 mm diameter PCCP; thus, fittings and adapters are compatible between the two, which is advantageous (more on this in Section 4.2.2.3). Note that the table includes information on the 900-mm diameter PCCP outfall gravity/force main that runs from the CVWPCC to the marine outfall at Cape Lazo; however, the 900 mm diameter PCCP is not in the scope of this Spill Response Plan.

It should be noted that with BWP, the steel cylinder is typically the main structural component of the pipe, not the steel bars, and the mild steel bars are thicker and wrapped under less tension than the thin, high-strength steel wire used in PCCP. Thus, the condition of steel cylinder is more important to the integrity of the BWP, while the condition of the steel wires is more important to the integrity of the PCCP.

The wastewater force mains have been protected to an unknown degree by an impressed-current cathodic protection (ICCP) system and anode bed(s). The protection of the full pipe lengths may be reduced by an anecdotal understanding that some of the bonding straps that bridge the bell and spigot joints may be missing or damaged. Without bonding straps, the corrosion protection systems cannot protect pipe sections that are not in continuous electrical contact.

Due to the age of the piping (approximately 35 years) and the severe operational conditions (raw wastewater inside and, in some areas, a marine environment outside), there is concern that the piping could fail at any time. There is a wide range of failure possibilities. Failure could materialize as a minor leak, a significant break or something in between. A failure would most likely be due to the corrosion of the mild steel cylinder and/or the mild steel bars, and perhaps deterioration of the concrete matrix.

1.4 RELEVANT DOCUMENTS

Background documents have been included in Appendix B and include the following:

1. Wastewater Force Main Drawings (Courtenay Pump Station to Goose Spit): alignments, plans and sections; Associated Engineering, 1983.
2. Wastewater Force Main Drawings (Goose Spit to the CVWPCC): alignments, plans and sections; Associated Engineering, 1983.
3. Wastewater Force Main Sketches and List of Components (Contract S-5; Courtenay and Jane Street Pump Stations to Goose Spit); Canron Inc. Pipe Division, 1982.
4. Wastewater Force Main Sketches and List of Components (Contract S-7; Goose Spit to the CVWPCC); Canron Inc. Pipe Division, 1982.
5. Wastewater Force Main Fabrication Drawings (Contract S-7; Goose Spit to the CVWPCC); Canron Limited Pipe Division, 1982.
6. Technical Memorandum: Field Visit and Repair Kit Assessment, including an inventory of aging Replacement Materials currently stocked by the CVRD at the CVWPCC, October 2016.

1.5 SPILL RESPONSE PLAN LIMITATIONS

It is Associated Engineering's understanding that the force mains in question have very limited options for bypassing their flows, and that there is minimal storage available in the wet wells and upstream sanitary sewers; thus, there is a very limited time period where the force mains can be offline. Because of the time required to locate and repair a failure in the force mains, the force mains will likely need to remain in operation until the leak has been located and the Replacement Materials/equipment/personnel are on site and ready. The minimal storage and shut-off period will be specifically designated for the repair period which will require the pipeline to be depressurized, and perhaps drained, to permit crews to make repairs.

That being said, it would be prudent for the CVRD to explore permanent options for increased emergency storage capacity and/or for bypass pumping. Associated Engineering has not considered increasing upstream storage, as this would require the design and construction of significant, permanent infrastructure, which would not fall under the scope of a Spill Response Plan. Associated Engineering has, however, briefly considered hot taps, line stops, and valve inserts, but these options are difficult and costly to implement, they risk damaging the force mains during installation, and they may not be able to cover all failure locations; brief descriptions of each are presented below.

Hot Tapping

Hot tapping is the strategic placement and installation of hot-tapped tees to allow for bypass pumping; this could be done ahead of time and valved or blanked off (if problem areas are identified) or after a failure. Note that hot tapping alone would only work if the failure is isolated on both sides by existing isolation valves, which means a large length of bypass piping will be required, as the hot taps would need to be installed upstream of the upstream isolation valve and downstream of the downstream isolation valve.

In the event of a failure, overland piping would be connected to the hot-tapped tees/valves and valves to permit emergency overland bypass pumping, thereby isolating the failed area and allowing crews to make repairs with minimal disruption to service. The main issues with hot tapping the CVRD's PCCP/BWP force mains include the following:

- The risk of severely damaging the force mains during installation.
- If done after a failure, the extended (multi-day) mobilization and installation period, which may not be feasible due to the need to get the force main back in service as soon as possible, and/or due to the environmental impact of numerous days of wastewater discharge.
- The reliance on existing force main isolation valves (whose reliability may not be known) for the bypassing, noting that the limited number and locations of the isolation valves greatly reduce the bypassing options.
- If done in anticipation of failures, the potential for numerous hot taps and, in the absence of new force main isolation valves, long-distance bypass pumping would be required.
- The cost.

Line Stopping

Line stopping consists of the localized, temporary isolation of a piping system where none exists, which, along with the above-mentioned hot tapping, allows for a temporary bypass without existing isolation valves on the force main. The main issues with this option include the following:

- The risk of severely damaging the force mains during installation.
- As this would be done after a failure, the extended (multi-day) mobilization and installation period, which may not be feasible due to the need to get the force main back in service as soon as possible, and/or due to the environmental impact of numerous days of wastewater discharge.

- The extended trench length required, which may not be feasible to construct and maintain in tidal zones.
- The cost.

Valve Inserts

Valve inserts consists in the installation of a permanent, inline valve, under pressure, with no interruption to service; this could be done where an isolation valve is required, but does not exist, and would be used in combination with the above-mentioned hot tapping. The main issues with this option include the following:

- The risk of severely damaging the force mains during installation.
- If done after a failure, the extended (multi-day) mobilization and installation period, which may not be feasible due to the need to get the force main back in service as soon as possible, and/or due to the environmental impact of numerous days of wastewater discharge.
- If done in anticipation of failures, the potential for numerous valve inserts, hot taps and/or long-distance bypass pumping in potentially difficult-to-access locations.
- The cost.

2 Spill Scenarios

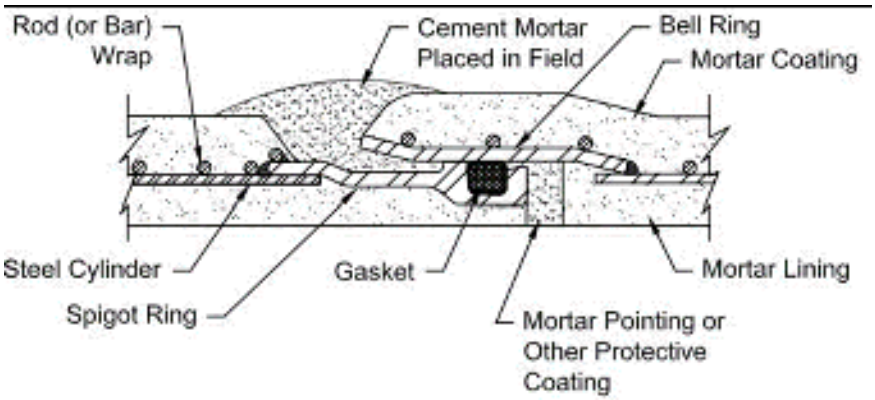
2.1 FAILURE TYPES

There are numerous failure types within the category of pressurized pipes ranging from small leaking joints resulting from gasket failures to catastrophic failure due to improper or insufficient restraints. For this report, consideration has been given to the most common failures for the types of piping in this plan's scope, with consideration to the pipes' current environment and operational conditions. Expected failures types are as follows:

2.1.1 Failure Type A: Corrosion of the steel cylinder and/or the steel bars/wires

The cement coating of the BWP/PCCP creates an alkaline environment for the steel cylinder and bars/wires; if this coating is damaged from improper installation, operations, adverse environments, etc., the coating will deteriorate and lead to the cylinder/bars/wires to come in contact with the elements. This will result in accelerated corrosion, pitting and even the breaking of bars/wires, weakening the affected area. If this condition continues over time, it will transition from a slow, localized leak to a larger, extensive leak. With the age of the pipeline, adverse environmental conditions, and the unknown degree of cathodic protection, there is the potential for numerous areas where there are existing slow leaks in the process of transitioning to larger, noticeable leaks. This failure type typical would occur in the middle section of pipes.

2.1.2 Failure Type B: Bell/Spigot Joint Failure



Early in the BWP/PCCP service life, the bell-and-spigot joints are considered the most durable area of the pipeline because of the increased thickness of the steel bell rings and steel spigot rings; over time, this durability advantage can change. The change can occur because of the deterioration of the cement mortar, which is installed in the field to complete the connection between the bell and spigot pipe ends. The cause of the field-applied cement mortar's deterioration is due to the lower cement-to-water ratio compared to the mortar lining that is factory applied. If the cement mortar deteriorates sufficiently, the aforementioned corrosion will take place, putting added pressure and reliance on the gasket. Leaks would typically have a low flow, although a minor change in ground conditions or a seismic event could shift joints in a way that would permit higher flows to discharge. This failure would occur at bell-and-spigot joints.

2.1.3 Failure Type C: Catastrophic Failure

While transient flow (a flow with changing velocity and pressure) is common and expected for this type of system, an extreme manifestation of transient flow is "water hammer", which is a pressure surge or pressure wave caused when a fluid is force to quickly stop or change direction. In recent years, CVRD operators have made some anecdotal observations stating there appears to be occasional short-term pressure spikes in the force main that can reach as high as 130 pounds per square inch (psi); efforts are currently underway to identify and eliminate the cause of the pressure spikes. If these extreme pressure spikes are happening, they could trigger a catastrophic failure in an already-weakened section of piping. These pressure surges have the potential to separate large sections of pipe or create large voids in the pipe instantly. This failure type typical would occur near changes in the pipes' horizontal or vertical alignment (i.e., near bends).

2.2 LOCATION TYPES

The prediction of failure locations for any pipeline is extremely difficult, which is why the generation of data that provides insight into the condition of a pipeline is useful. It is our understanding that, in 2017, the CVRD plans to complete condition assessments/advanced pipeline scanning to provide data that could aid in the detection of potential pipeline problem areas. As such, the general predictions suggested on this report should be adjusted accordingly with the results of the condition assessment to better refine true weak areas in the pipeline. For this report, Associated Engineering has divided the pipeline into three general location types, and they are as follows:

2.2.1 Location Type A: Land, Near Roads

This is likely the least demanding of repair locations, but will have its own challenges: traffic management; wastewater containment, collection and/or diversion, depending on the flow; and road reconstruction/repair once the repairs to the piping are complete.

2.2.2 Location Type B: Tidal

This is a difficult location type, requiring the following considerations: environmental protection; issues getting equipment and materials down to the repair location; dewatering of excavation; and short repair windows due to tidal fluctuations.

2.2.3 Location Type C: Goose Spit Bay

This is the most difficult repair location, due to the adverse ground conditions (i.e., mud, sediment), in addition to the considerations of Location Type B (environmental protection; issues getting equipment and materials down to the repair location; dewatering of excavation; and short repair windows due to tidal fluctuations).

3 Regulatory Compliance and Notifications

This Spill Response Plan is based on federal, provincial, and municipal environmental regulations. This section identifies the public agencies, stakeholders, and other organizations that are to be contacted and notified in the event of a spill. The information on notifications is presented in two sections:

- Mandatory reporting requirements (those that are specified by regulation or where a regulatory body could otherwise be involved); and
- Recommended, but non-mandatory reporting (for key stakeholders and local media).

Table 3-1 at the end of the section lists the contact information for each organization. If a spill occurs, the mandatory notifications must occur immediately (Section 3.1). After the spill is contained, on-going communication with the regulatory bodies would be required to coordinate clean-up (Section 3.5).

The applicable regulations and governing bodies relevant to spill response in the project area include:

Federal

Canadian Environmental Protection Act (CEPA) – Environment and Climate Change Canada
Fisheries Act – Canada Coast Guard/Fisheries and Oceans Canada (DFO) and Environment Canada
Migratory Bird Convention Act - Environment Canada

Provincial

Environmental Management Act – BC Ministry of Environment
WorkSafeBC
Vancouver Island Health Authority

Municipal

Comox Valley Regional District
Town of Comox
City of Courtenay

First Nations

K'omoks First Nation

3.1 MANDATORY ENVIRONMENTAL NOTIFICATIONS

BC Ministry of Environment

The BC Ministry of Environment (MoE), through the Provincial Emergency Program (PEP), is the primary point of contact for spills or other accidental releases of contaminants within the project area. Municipal wastewater is covered under the Spill Reporting Regulations of the BC *Environmental Management Act*, under Schedule No. 24 – "a substance that can cause pollution". The threshold amount of a spill that requires reporting is 200 litres (0.2 m^3) or 200 kg. **Reporting must occur immediately**; therefore, any spill that appears to be even close to this amount should be reported rather than delaying to confirm volume.

The contact telephone number is **1-800-663-3456**. Mobile phone applications for reporting spills are available from the MoE Environmental Emergency Program web site[1]. CVRD Public Works staff members should have the app on their work phones to enable a quick response. The following information must be supplied when reporting, as practically possible:

- The reporting person's name and telephone number.
- The location and time of the spill.
- The type and quantity of the substance spilled.
- The cause and effect of the spill.
- The name and telephone number of the person who caused the spill, if caused by an action.
- Details of action taken or proposed to stop, contain and minimize the effects of the spill.
- A description of the spill location and of the area surrounding the spill.
- The details of further action contemplated or required.
- The names of agencies on the scene.
- The names of other persons or agencies that have been or will be advised concerning the spill.

A reporting template (**Table 3-2**) for the above information has been provided at the end of this section.

[1] See http://www2.gov.bc.ca/gov/content/environment/air-land-water/spills-environmental-emergencies/report-a-spill

Canadian Coast Guard (Fisheries and Oceans Canada)

The Canadian Coast Guard is a Special Operating Agency of Fisheries and Oceans Canada (DFO), and is the first point of contact within the federal government for marine pollution incidents. The contact number for BC is **1-800-889-8852** (24 hours). The role of the Coast Guard in emergency response is anticipated to increase as part of the federal governments Canada's Oceans Protection Plan.

Environment and Climate Change Canada

The Canadian Environmental Protection Act (CEPA) requires spill reporting, but reporting is through the BC Environmental Emergency Program number listed above (**1-800-663-3456**). The project area provides habitat for migratory bird species. Under the *Migratory Bird Convention Act* any accidental or intentional discharge of oil, oily waste, or any substance harmful to migratory birds in any waters or any area frequented by migratory birds must be reported. Again, this is via the main phone number.

Fisheries and Oceans Canada

The Fisheries Act prohibits the release of deleterious substance to fish-bearing waters. Although the *Fisheries Act* is administered by the Minister of Fisheries and Oceans, the federal Minister of the Environment (i.e. Environment Canada) is responsible for the sections of the *Fisheries Act* that deal with water pollution. Therefore, notification is handled through the main BC Environmental Emergency Program number provided above (**1-800-663-3456**).

3.2 MANDATORY HEALTH & SAFETY NOTIFICATIONS - WORKSAFEBC

WorkSafeBC must be notified when there is a major release of a hazardous substance that could affect workers' health and safety. The term "major release" is not specifically defined for municipal wastewater, but is prudent to use the same 200 litres threshold as the environmental emergency reporting requires. This notification would be necessary if CVRD personnel or contractors are involved in spill control and clean-up.

3.3 RECOMMENDED NOTIFICATIONS

In addition to the mandatory spill reporting requirements listed above, there other agencies and stakeholders that should be notified as part of normal due diligence, based on land and water use in the project area.

Vancouver Island Health Authority (VIHA)

The Health Protection and Environmental Services Branch of VIHA has responsibility for health protection of recreational waters and beaches, and for communicable disease control. The Branch should be notified because a spill of untreated wastewater could affect public health at beaches and recreational waters.

First Nations and Public

- K'omoks First Nation (KFN) – KFN has significant interests in land use, fisheries, and water quality in the project area.

- Public through local media communications – The key media outlets that should be notified are CHEK News, Comox Valley Echo Newspaper, Comox Valley Record Newspaper, 97.3 The Eagle Radio, and 98.9 The Goat Radio.
- City of Courtenay and Town of Comox.
- Project Watershed Society – Stakeholder with interest in the K'omoks Estuary.

Industry

The marine water near the force main and in nearby areas of Baynes Sound are utilized for commercial and traditional shellfish harvesting. Industry organizations that should be contacted include the BC Shellfish Growers Association and the First Nation Fisheries Council.

3.4 HEALTH AND SAFETY REQUIREMENTS

Workers involved in spill control and clean-up should follow the same practices that apply to workers in wastewater treatment facilities in British Columbia. The following are procedures adapted from the Wastewater Treatment Plant Occupational Health and Safety Bulletin published by the Canadian Union of Public Employees (2015); the full document has been included in Appendix F.

- Ensure that all WorkSafeBC requirements are followed throughout the duration of all spill control, containment, and cleanup activities.
- Ensure that all workers are aware of the hazards associated with working with untreated municipal wastewater (sewage). A daily "tailgate meeting" should be held prior to beginning work to review and health and safety procedures.
- Use appropriate protective clothing at all times (i.e., liquid-repellent coveralls) and personal protective equipment (PPE – rubber boots, rubber gloves, plastic face shields) and, where required, wear respiratory protective equipment.
- Avoid direct contact with sewage.
- Avoid aerosolizing sewage water, or minimize exposure time in areas where aerosolizing is occurring. If working in a confined space, make sure ventilation systems are functioning properly when working around areas where sewage may be aerosolized.
- Thoroughly cleanse all exposed injuries with soap and water and keep them covered with a bandage (preferably waterproof) while at work. Seek medication attention immediately after suffering cuts or penetrating injuries.
- If a worker is suffering from a skin problem, they should see a physician to secure clearance before working with sewage.
- Avoid touching the face, mouth, hands, eyes or nose with dirty hands or other items and avoid nail biting.
- Thoroughly wash the hands and face with soap and water before eating, drinking or smoking.
- Eat or smoke in designated areas away from sewage contamination. These areas must be kept free from contamination by leaving any protective clothing and boots in a separate area, for example.
- Remove personal protective clothing and footwear at the end of the shift and leave it at work. Dispose of any disposable PPE is the proper container.

- Shower and change out of work clothes before leaving work.
- Report any damaged equipment.
- Report all work-related symptoms to the employer and the physician. These may include:
  - cramping stomach pains, diarrhea, vomiting;
  - yellowing of the skin;
  - symptoms of breathlessness, chest tightness and wheezing;
  - redness and pain of the eyes; and
  - skin rash and/or pain.

3.5 COMMUNICATIONS AND AUTHORIZATION FOR CLEAN-UP

No permit or other form of provincial or federal authorization is needed before proceeding with spill response or clean-up, although on-going regular contact with the BC Environmental Emergency Program and DFO is recommended to ensure that the proper guidelines and procedures are followed. Response and clean-up actions should avoid potential damage to riparian and aquatic habitat.

Table 3-1
Emergency Spill Notification Contacts

Contact Name	Contact Number	Mandatory Contact (Y/N)
MANDATORY		
Environmental Emergency Reporting (BC MoE & Environment Canada)	1-800-663-3456	Y
Canadian Coast Guard 24-hour marine spill reporting	1-800-889-8852	Y
WorkSafeBC 24-hour Worksite Emergency Reporting	1-888-621-7233	Y
NON-MANDATORY, BUT RECOMMENDED		
BC Ministry of Environment (MoE), Environmental Protection Division – Nanaimo (to supplement Environmental Emergency Reporting - above)	250-751-3100	N
Vancouver Island Health Authority Health Protection and Environmental Services, Comox Valley	250-331-8518	N
K'omoks First Nation	250-339-4545	N
City of Courtenay, Public Works	250-338-1525 or 250-334-2947	N
Town of Comox, Public Works	250-339-5410	N
CHEK News	250-480-3700	N
Comox Valley Echo Newspaper	250-334-4722	N

Contact Name	Contact Number	Mandatory Contact (Y/N)
Comox Valley Record Newspaper	250-338-5811	N
97.3 The Eagle Radio	250-703-0199	N
98.9 The Goat Radio	250-334-2421	N
Project Watershed Society	250-703-2871	N
BC Shellfish Growers Association	250-890-7563	N
First Nation Fisheries Council	778-379-6470	N
Department of National Defense/CFB Comox	250-339-8211	N

Table 3-2
Environmental Incident Form (expand/customize if needed)

Date of Incident: _____	Time of Incident:	AM ☐ PM ☐
Name and contact of person that discovered incident:		
Name and contact of person that caused incident:		
Location of incident (include landmarks and features, nearest cross street, pipe type/size):		
Extent of incident (provide a sketch if necessary):		
Quantity or volume of material incident:		
Estimate of distance to nearest waterway (including stormwater drains and dry watercourse):		
Type of activity that caused the incident (works in progress at time of Incident):		
Name of people on scene of incident:		
Level of incident:		
☐ Minor	e.g.no material has escaped the site or caused material to harm the environment. It is easy to clean up without additional assistance.	

☐ Major	e.g. material has escaped site causing pollution of downstream areas which will require clean up involving other agencies or resources. Review *Environmental Management Act* for details on spill reporting quantities.
Incident Commander:	
Lead Agency:	
Name of agencies or other persons advised of the spill:	
Any other details of the incident:	
Corrective action taken:	

4 Spill Response Steps and Repair Methodology

4.1 SPILL RESPONSE STEPS

Spill response checklist included, see Appendix H.

4.1.1 Identify, Confirm and Document the Spill

Quickly fill out Table 3-2; leave blank answers if information is missing at this point. The first CVRD employee to learn of a spill should fill out Table 3-2 as soon as they can and as best they can.

In the event of a significant failure, it is likely that someone (likely the public) will notice wastewater surfacing near the failure location. A significant failure could also be identified by an unexpected piping system pressure drop and/or operators may notice an decrease in flow to the treatment plant. Pump speeds, wastewater flows, and piping system pressures should be monitored; it is recommended that the supervisory control and data acquisition (SCADA) system be programmed to alarm when the system pressures and/or the flows entering the plant are not in line with the pump speeds.

Locating a minor leak can range in difficulty depending on many factors, including depth of leak, soil type(s), ground cover, and flow rate of the leak. Minor leaks may never be identified; however, it is possible that even minor leaks could be identified by damp and/or odourous ground conditions. CVRD crews may be required to walk the force main pipe alignment to inspect all appurtenances and observe any soft spots or unknown discharge of fluids. If visual inspections fail to locate a general leak area when a leak is suspected, more precise equipment can be utilized such as leak correlators, listening rods and ground microphones.

If a minor leak is suspected, careful excavation (ideally using a hydrovac truck and/or hand tools such as shovels) should be carried out to investigate and confirm the potential leak, as a small leak will likely deteriorate over time, as it indicates a possible weak point in the piping system. Before any digging, read Section 4.1.3.

4.1.2 Notifications and Initiation of the Response

Notify the CVRD personnel indicated in Table 4-1. The first CVRD employee to learn of a spill should ensure that the CVRD personnel identified in Table 4-1 are notified as soon as possible; ideally in the order they are presented.

Table 4-1
CVRD Notifications

Name	Title	Office phone	Cell phone	Alternate
Mike Imrie	MGR Wastewater Services	250 339 5231	250 218 2924	Mark Zanders
Kris LaRose	Senior Manager of Water/Waste	250 334 6083	250 218 6689	Mike Imrie
Marc Rutten	GM of Engineering Services	250 334 6080	250 703 3166	Kris LaRose
Mark Zanders	Chief Operator	250 339 5231	250 941 2659	
Howie Siemens	CV Emergency program coordinator	250 334 8890	250 334 6488	
Christianne Wile	Manager of Operational Communications	250 334 6066		
Russell Dyson	Chief Administration Officer	250 334 6055		Mark Rutten

The first senior CVRD staff member to be notified of the spill should notify the following organizations, providing the information from Table 3-2:

BC MoE & Environment Canada (Environmental Emergency Reporting)	1-800-663-3456
WorkSafeBC (24-hour Worksite Emergency Reporting)	1-888-621-7233
Canadian Coast Guard (if there are marine implications) *	1-800-889-8852

** If the spill is minor (i.e., a minor leak that is not likely to reach the beach, tidal zone and/or marine environment), then notifying the Canadian Coast Guard (Fisheries and Oceans Canada) is likely not necessary.*

Carry out an Initial Spill Response Meeting. The meeting should consist of as many of the Table 4-1 CVRD personnel as possible; however, the meeting should also take place as soon as possible to initiate the spill response. The Initial Spill Response Meeting should **assign an Incident Commander**, who will manage the spill response through direct action and delegation. The Initial Spill Response Meeting should quickly go through the steps identified in Section 4 of this Spill Response Plan, including making decisions on what outside help (i.e., contractors, consultants) is required (see Table 4-2), making decisions on the non-mandatory (but recommended) notifications listed in Table 3-1, and making decisions on who is doing what (the Incident Commander can delegate tasks).

Table 4-2
Contractors and Consultants

Hydrovac/Pumper Services	Civil Contractors	Engineering Consultants
Badger Daylighting 778 585 0091 Jay Love 24 hr. contact 250 618 3252	JR Edgett Excavating 250 339 6100 Bruce Henderson 24 hr. contact 250 703 3787	Associated Engineering 604 293 1411 Leif Marmolejo, Tom Robinson
Walco Industries 1 888 599 2526 Charlie Walcot 24 hr. contact 250 203 4742	Wacor Holdings 250 287 9644 Dave Atkinson 24 hr. contact 250 287 4742	
Wacor Holdings 250 287 9644 Dave Atkinson 24 hr. contact 250 287 4742	Leighton Excavating 250 338 6460 Robert Leighton 24 hr. contact 250 898 3012	
City of Courtenay & Town of Comox	Ridgeline Contracting Garth O'Neil 24 hr. contact 250 898 7648	

Carry out non-mandatory (but recommended) notifications (see Table 3-1). The decisions on the non-mandatory notifications should be on a case-by-case basis, depending on who might be affected. Depending on the severity of the leak/spill, residents and businesses may be urged to minimize water use (and toilet flushing) until repairs have been made.

Contact the contractors and consultants that will be assisting with the spill response (see Table 4-2) and confirm ability/availability to assist.

Depending on the flow rate of the leak, the CVRD and available contractors should **attempt to contain and collect the leaking wastewater**; for example, a ditch could be dug and lined with an impermeable geomembrane, and two pumper trucks could take turns collecting wastewater and trucking it to the CVWPCC.

4.1.3 Excavation

If the exact location of the leak is not known yet, follow the advice in the last two paragraphs of Section 4.1.1. Prior to excavation, **secure the site and the excavation to protect the public and workers** as per the Occupational Health and Safety Regulation (OHSR) Parts 20.78 through 20.95 (Excavations).

Record drawings are helpful for locating the force mains; however, the drawings are 35 years old and should not be relied upon to locate any existing pipe crossings or service lines such as Fortis, BC Hydro, CVRD water, and CVRD storm. **Contact BC One Call (1-800-474-6886) prior to excavation.** Associated Engineering also recommends that the CVRD contact BC One Call before a pipe failure occurs, to document all pipes and service lines that currently cross (or are otherwise near) the force mains; this proactive approach will expedite the repair process by providing up-to-date information on existing adjacent utilities. If utilities are known to be near the failure location, a utility-locating company should be used to provide current utility information and to assist with the excavation work.

Follow proper daylighting/hydrovacing techniques to expose utilities and to expose the damaged/leaking area of the pipe, as per OSHR Part 20.79 (Underground Utilities). Take precautions to prevent further damage to the pipe, and to ensure the pipe is sufficiently supported by the surrounding soils or temporary supports.

4.1.4 Determine the Failure Details and Plan the Repair

Carry out a Spill Site visit with key parties (i.e., key CVRD personnel, contractors, consultants). If it has not yet been done, and if it is possible, **attempt to contain and collect the leaking wastewater**; for example, a ditch could be dug and lined with an impermeable geomembrane, and two or more pumper trucks could take turns collecting wastewater and trucking it to the CVWPCC. The Incident Commander should **update Table 3-2 and provide updates to the agreed-to organizations**.

Once the failure has been exposed, **fill out an Emergency Repair Questionnaire** (ERQ); see Appendix D for a blank ERQ. The ERQ will determine the failure type, location, pipe dimensions, pipe class and many other vital details that will aid in determining the repair methodology. **Distribute copies of the completed ERQ and the updated Table 3-2** to all parties that will be assisting the CVRD with the repairs.

Carry out a Repair Planning Meeting with the key parties (i.e., key CVRD personnel, contractors, consultants) and, using the available information (i.e., the ERQ, Table 3-2, the background documents noted in Section 1.4), **determine and document the Repair Methodology**.

4.2 REPAIR METHODOLOGIES

4.2.1 Repairing Minor Leaks Without Replacement of Components

If minor leaks are discovered, repairs could follow the procedures set out by Forterra (see first document in Appendix E) if the decision is made to not replace any piping components. Similarly, if the CVRD wishes to replace a piping component or two, but decides to do it at a later date, then the Appendix E repair procedures could be used to temporarily stop the leaking and allow the CVRD to better plan the replacement work; for example, a leaking joint could be repaired temporarily, allowing the CVRD to secure contractors for a late-night, low-tide replacement job, days or weeks later.

Note that, even with the repair of a minor leak, most of **the requirements and steps listed in Section 4.2.2 below (and Section 4.1 above, for that matter) will apply**.

Repair Materials; see Appendix C for additional details

- One (1) steel patch, 300 mm tall and 900 mm long, matching the outside radius of the 450-mm dia. pipe's steel cylinder, for welded repair procedure (see first document in Appendix E).
- Two (2) bolt-on clamps to allow the cutting of high-strength wires on 750 mm dia. PCCP, for weld-on repair saddle procedure (see first document in Appendix E).
- One (1) weld-on repair saddle, 900 mm long, for weld-on repair saddle for 750 mm dia. PCCP (see first document in Appendix E).
- Two (2) steel patches, 400 mm tall and 900 mm long each, matching the outside radius of the 820-mm dia. pipe's steel cylinder, for welded repair procedure (see first document in Appendix E).

4.2.2 Replacement of Piping Component(s)

Follow this section's recommendations for labour, equipment, Replacement Materials and repair steps for the replacement of piping components. The installation of Replacement Materials should follow the detailed procedures set out by Forterra (see second document in Appendix E).

4.2.2.1 Labour

The expected repairs will be difficult and all work forces involved shall be qualified and familiar with repairs to BWP/PCCP. Labour recommendations include, but are not limited to, the following:

- Civil construction crew consisting of a minimum of:
  - Two (2) pipelayers
  - One (1) foreman

  - Two (2) excavator operators
  - Two (2) labourers
  - One (1) backhoe operator.
- Traffic control persons as location of failure and activities require.
- Hydrovac/daylighting contractor.
- Pumper truck contractor.
- Utility Locator contractor.
- *Dewatering contractor, if groundwater or seawater is likely to enter the excavation.*
- *Paving contractor, if repair work will damage an existing road.*

4.2.2.2 Equipment

The following recommended equipment should be readily available to complete repairs:

Basic Equipment

- Two (2) medium-duty steel trench shields, 2 m wide x 8 m length x 3 m height.
- Two (2) 300-series excavators.
- One (1) 544k front-end loader, backhoe, crane or side-boom tractor for handling pipe.
- One (1) 2-in. electric powered (min. 1hp) trash/submersible pump and associated hoses.
- One (1) 3-in. gas powered (min. 8hp) trash pump and associated hoses.
- One (1) (min. 10kW) gas/diesel powered generator.
- Three (3) sets of all-weather emergency (1kW) lights including posts/tripods.
- One (1) 14-in., carbide-tipped, (3.5kW) gas powered circular saw, including attachment to a water source to enable dust suppression, and associated safety gear such as a dust mask and goggles.
- Two (2) Tandem-axle dump trucks.
- One (1) Hydrovac trucks for daylighting.
- Two (2) or more pumper trucks for taking turns collecting and trucking wastewater.
- Hand tools (i.e., shovels, picks, spades, wrenching equipment, torque wrench, trowels, chisels, hammers, paint brushes).
- One (1) pneumatic chipping gun (for removing the piping's concrete outer layer along with the chisels, hammers, grinder).
- One (1) pneumatic 4-in. grinder (for prepping exterior of pipe, smoothing cuts).
- Fabric/nylon straps/slings, chains and cables for handling pipe (pipes are not to come into direct contact with forks, chains or cables; only use fabric/nylon straps/slings).
- One (1) 1000-lb plate tamper.
- Two (2) come-alongs (hand-powered ratcheting winches).
- One (1) feeler gauge.
- One (1) jump jack compactor.
- Four (4) ratchet-type hoists or chain hoists.
- Filler rod or bar to reduce the joint gap when welding.
- Portland cement, sand and water for making mortar and concrete.

- Adequate personal protective equipment (PPE) for all workers as per regulations, including high-visibility vests, and PPE to prevent direct contact with wastewater (i.e., impermeable gloves, goggles/face shields, rubber boots, water resistant coveralls). See Section 3.4 and Appendix F for wastewater-related information and precautions.
- Traffic control materials (i.e., barriers, cones, hand-held stop signs, lights, detour signage).
- Four (4) pneumatic/inflatable pipe plugs (to reduce the volume of wastewater that needs to be drained from the force main by reducing the length of isolated force main and/or to stop the flow of wastewater that was not able to be drained by pumper trucks once a force main is removed).
- One (1) portable (min. 50CFM, additional tools not mentioned above may require extra capacity) gas/diesel powered air compressor for pneumatic tools and for inflating the pneumatic/inflatable pipe plugs.

Additional Equipment

- Dewatering equipment (if groundwater or seawater is likely to enter the excavation).
- Paving equipment (if repair work will damage an existing road).
- One (1) extra medium-duty steel trench shield, 2 m wide x 8 m length x 3 m height (if several piping components require replacement).
- Two (2) manhole trench shields, which will prevent predicted bank sloughing from entering the work zone as crews make repairs.
- One (1) 400-series excavator; this larger excavator will provide a further lifting range if excessive trench sloughing is anticipated (i.e., in a tidal area).
- Swamp or excavator mats to allow machine access to affected area; dimensions of mats shall be 1.5 m x 6 m, mats can be constructed of 300 mm x 300 mm timbers.
- Aggregate/fill and heavy civil equipment for constructing a temporary access/ramp down to a Spill Site in a tidal area; this access/ramp would be used by excavators, hydrovac trucks, etc.

4.2.2.3 Repair and Replacement Materials

Trench Materials

- Backfill materials for the trench (see Figure 4-1).
- Non-woven geotextile (Nilex 4545).
- Ten (10) 25-kg bags of SikaQuick 2500 (one-component, very-rapid-hardening, early-strength gaining, cementitious, repair mortar) for use in repairing BWP/PCCP, sealing BWP/PCCP joints, or for thrust blocks (see last bullet).
- *Paving materials (see Figure 4-1), if repair work will damage an existing road.*
- *Six (6) Lock-Block-type pre-cast concrete blocks, if a new bend requires a thrust block to be quickly assembled; these blocks could be used in conjunction with wood-based formwork and rapid-hardening repair mortar to fill in the gaps; consult with a qualified Professional Engineer for arrangement and details.*

Corrosion-Protection Materials

- Denso Paste
- Denso Mastic
- Denso Tape
- Epoxy paint for recoating the ends of steel pipe that required cutting (shortening) and for touching up damaged (i.e., chipped, scratched) piping, fittings and couplings.
- Materials for maintaining electrical continuity through replaced component(s) (i.e., bonding cables/straps, thermite welding of straps to the steel cylinder), if repair window (schedule) allows (if the schedule does not allow, this can be done at a later date).

Replacement Materials for 450-mm-diameter BWP (from CVWPCC storage areas); see Appendix C for additional details)

- One (1) 450-mm-dia. adapter, bell x plain steel end with gasket.
- One (1) 450-mm-dia. adapter, spigot x plain steel end with gasket.
- Three (3) 450-mm-dia. couplings.
- Two (2) 450-mm-dia. steel pipes each with a 450-mm-dia. Tee (with blind flange and gasket) in the centre. Length for each is 5.883 m since, together with two of the above-noted adapters, this length will allow the replacement of a standard/7.315-m length of pipe; if the pipe to be replaced is less than 7.315 m, this steel pipe can be cut to size.
- One (1) 450-mm-dia. steel pipe, 7.315 m long. This length, together with two adapters and the above-noted 5.883-m steel pipe spool, will allow the replacement of two standard/7.315-m lengths of pipe; the pipe can also be cut to size if needed.
- Two (2) extra 450-mm-dia. BWP bell/spigot gaskets with lubricant.

Replacement Materials for 750-mm-diameter PCCP and 820-mm-diameter BWP (from CVWPCC storage areas); see Appendix C for additional details)

- Two (2) 750-mm-dia. steel adapters, bell x plain steel end with gaskets.
- Two (2) 750-mm-dia. steel adapters, spigot x plain steel end with gaskets.
- Four (4) 750-mm-dia. couplings.
- Two (2) 750-mm-dia. steel pipes each with a 750-mm-dia. Tee (with blind flange and gasket) in the centre. Length for each is 5.883 m since, together with the two of the above-noted adapters, this length will allow the replacement of a standard/7.315-m length of pipe; if the pipe to be replaced is less than 7.315 m, this steel pipe can be cut to size.
- Two (2) 750-mm-dia. steel pipes, each 7.315 m long. This length, together with two adapters and the above-noted 5.883-m steel pipe spool, will allow the replacement of two standard/7.315-m lengths of pipe; the steel pipe can also be cut to size if needed.
- Four (4) 750-mm-dia. 11.25-degree bell-and-spigot elbows with gaskets.
- Four (8) extra 750 PCCP/820 BWP bell/spigot gaskets with lubricant.

Note that the Replacement Materials listed in Appendix C should be used before the aging Replacement Materials listed in Figure 1 of the October 2016 Tech Memo (at the end of Appendix B) are used; however, if extensive repairs and/or new Replacement Materials are not available, the aging Replacement Materials that apply to the 750 PCCP/820 BWP could be used (these are in the yellow areas of Figure 1).

4.2.2.4 Repair Steps

Associated Engineering has determined that the following three replacement scenarios should cover most replacement situations:

- Replacement 1: Replacement of one (1) length of pipe (this would be required if the damage is limited to a single pipe section).
- Replacement 2: Replacement of two (2) adjacent lengths of pipe (this would be required if the damage is on two adjacent sections of pipe, such as damage on both sides of a joint).
- Replacement 3: Replacement of one (1) length of pipe and one (1) elbow (this would be required if the damage is to an elbow, or for damage to both sides of an elbow's joint). *

** This replacement only covers pipe bends (elbows) that are approximately 6 to 26 degrees. Bends lower than 6 degrees can be accommodated by the flex available in the bell/spigot joints combined with the flex available in the coupling(s). Bends higher than 26 degrees appear to be encased in concrete thrust blocks, making them far less likely to fail. Note that the tee section of the replacement pipes could be used/modified to create a Tee fitting, a Y fitting, a 90-degree elbow, or other large-angle bends; cutting, welding, couplings and/or 11.25-degree elbows may be required to create these fittings. Also, the tee section of the replacement pipes could be used for future bypass pumping; however, consult a qualified Professional Engineer in case a thrust block is required.*

See Table C-1 and Figures C-1, C-2, C-3 and C-4 in Appendix C for details on some of the replacement scenarios.

Replacement 1: Replacement of One (1) Length of Pipe

1. If the spill site is in a tidal zone or if groundwater is expected to be a problem, arrange for a dewatering system with a dewatering contractor.
2. Implement traffic control plan. If work impacts the entire road width, implement detours through barriers and signage. If work impacts less than half of the road width, use more than one traffic control person to maintain single-lane traffic. If work is well off the road, one traffic control person may be sufficient to allow construction vehicles safe entry and exit from the road to the Spill Site.
3. If the Spill Site is in a tidal zone, wait for low tide; plan to enter the work area as soon as the receding water level allows it.
4. Enter the work area and commence the repair excavation (a smaller, exploratory excavation may have already been carried out at this point to determine the failure details) utilizing backhoe or excavator to complete the primary bulk removal of ground (and asphalt and subbase if within a road area); stop excavation within 1 m of the top of the pipe.

5. Within 1 m of the expected top of the pipe, a hydrovac truck will be used to safely expose the pipe by utilizing non-destructive daylighting techniques. The use of an extended spray wand and a remote-controlled Hydrovac vacuum extension will avoid any personnel from entering trench while excavating pipe. ***At no point shall personnel be within trench of the failed pipe while line is under operating pressure or before the trench shields are installed.***
6. Visually confirm the location and details of the failure; adjust repair plans and materials if necessary.
7. Shut down and lock out the Courtenay and Jane Street Pump Stations, and depressurize the associated force mains. Proper lock and tag out procedures must be utilized. The CVRD has noted that the Courtenay and Jane Street Pump Stations can each be shut down for approximately 20 minutes at peak flow (9 a.m. to 7 p.m.), and for 40 minutes at low flow (3 a.m. to 4 a.m.); these are very short windows and, thus, it will likely be necessary to implement measures that will extend these shut-down periods. Appendix G contains information on things that the CVRD could attempt to carry out to increase the allowable shut-down periods for the two pump stations.
8. Isolate the failed section of force main using the nearest upstream and downstream isolation valves. Line valves are located at stations 2+034, 4+606 and 6+700. If failure is between 0+000 to 2+034, turn line valve at 2+034 off; a high point at 0+340 will prevent further gravity flow from upstream pipes.
9. Expose the failed pipe section, including its bell and spigot joints; however, do not remove the supporting ground/bedding beneath the piping (doing so may cause damage as the joints take the weight of the pipe section).
10. Install steel protective trench shields. One lengthwise trench shield will be required for a single pipe section replacement.
11. If feasible, use pneumatic/inflatable plugs at the nearest upstream and downstream access hatches to further isolate the failed section of pipe.
12. If feasible, begin draining the failed/isolated section of pipe using two or more pumper trucks, which will take turns draining the pipe section and discharging wastewater at the CVWPCC; the drain point(s) would need to be at applicable blow downs, air valves, access hatches and/or 750 mm square opening (see next step).
13. If one or more drain points are required, but existing pipe access points (see previous step) are not feasible, cut a 750-mm square opening on the top of the pipe at the failure location utilizing a 14-in. circular saw; use water for dust suppression. ***Follow Forterra instructions (Appendix E) to safely cut the pipe, as there is a potential for injury from bar/wire recoil.***
14. If feasible, drain the isolated pipe section using pumper trucks. If draining the isolated pipe section is not feasible (due to the volume of wastewater in the isolated pipe section and the limited time window available to have the pump stations shut down), then the wastewater between the isolation points will need to be spilled out of the piping when the damaged pipe section is cut/removed. Ideally, a trench and collection pond can be constructed ahead of the emptying of the force main section to allow the collected wastewater to be pumped out and hauled to the CVWPCC; however, site conditions, schedule constraints (i.e., pump station shutdown times, tides) or sheer volume of wastewater may require the wastewater within the isolated piping section to be directed via a constructed trench into the ocean.
15. Use the 14-in. circular saw to cut and remove a 3-m section of pipe between the bell and spigot ends.
16. Remove 3 m section of pipe. Sand bags or pneumatic/inflatable plugs can be used in the upstream and/or downstream pipe sections (that are to remain in place) to prevent any remaining wastewater from flowing out of the piping; ***note that provisions will need to be made for their eventual removal***.

17. Crews will need to chip away the field-applied cement grout joint filler (from the joints that are on either side of the piping that is to be removed). Prior to pulling joints apart, crews will also need to inspect if welds are present at joints; if welds present, a 4-in. orbital grinder will need to be used to cut or grind the welds off, careful not to damage the bell or spigot ends of the pipes that will remain in place. Carefully dislodge the sections of pipe that require removal using an excavator and choker cables.
18. After the complete removal of the damaged piping, inspect the adjacent bell and the adjacent spigot (on the piping that is to remain in place) for damage from corrosion or the removal process. Any piping that has been removed should undergo a condition assessment, including testing and analyses, to determine its condition (i.e., concrete, steel cylinder, bar/wires) and what caused the failure; this evaluation will provide insight into the rest of the piping's condition.
19. Over-excavate and place bedding for the new piping; see Figure 4-1 for typical trench details.

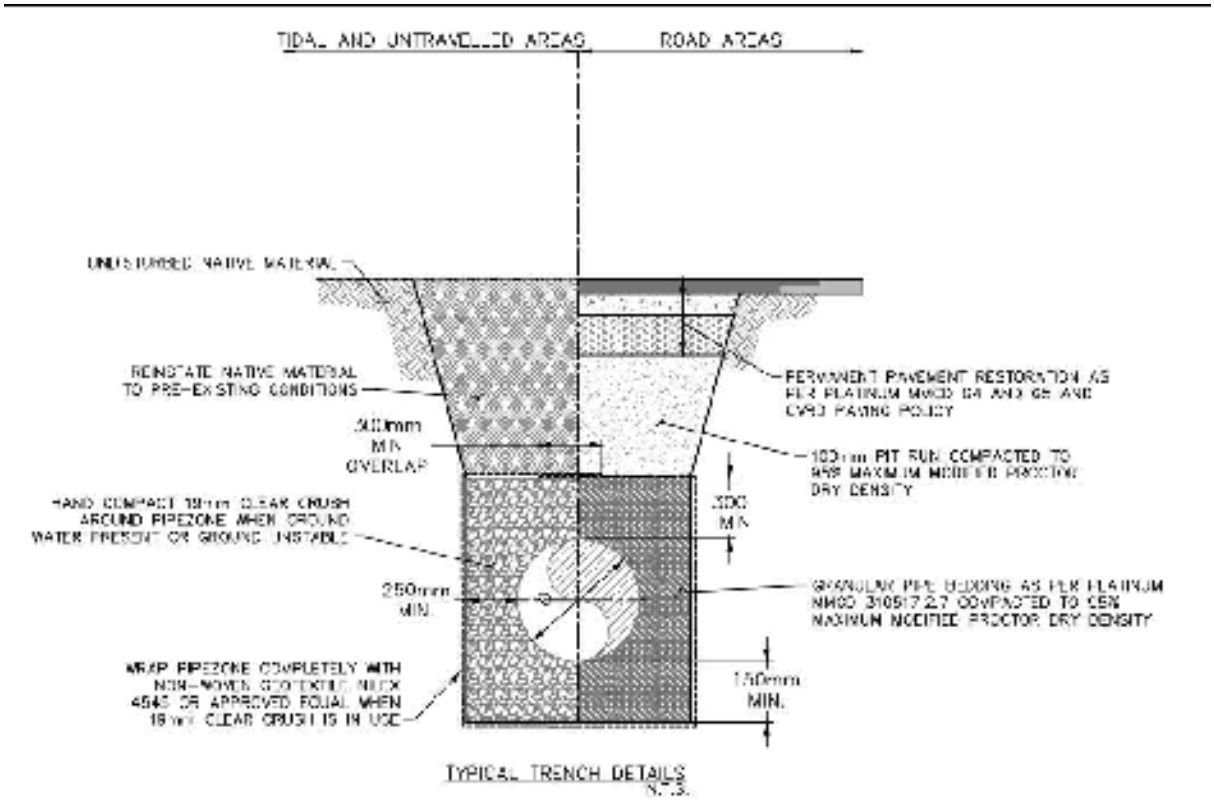


Figure 4-1
Typical Trench Details

20. Ensure the bell-and-spigot joints are free of debris, use new gaskets (for the applicable diameter), and ensure the gaskets are installed to manufactured recommendations; apply appropriate lubrication.
21. Install the applicable bell-to-plain steel end adapter fitting (for the applicable diameter) to the spigot end of the existing piping.

22. Install the applicable spigot-to-plain steel end adapter fitting (for the applicable diameter) to the adjacent bell end of the existing piping.
23. Measure the remaining distance between the two adapters, and cut the replacement steel piping to that length minus 2 in. (to leave a 0.75- to 1.5-in. gap on either side of the pipe section). Only one end of the steel pipe needs to be cut, unless the required length of the replacement section is so short that the Tee will interfere with the cut; in that case, half of the required cut should be made on both ends. Note that the 750-mm-dia. steel pipe is to be used for both the 750-mm-dia. PCCP repair, and the 820-mm-dia. BWP repair.
24. Grind smooth the cut end(s) of the replacement steel pipe and, using the appropriate epoxy-based paint, recoat the pipe end(s) (inside, outside and edge), and touch up any chips or scratches anywhere else on the piping.
25. Slide each coupling (of the applicable diameter) onto the ends of the two adapters.
26. Carefully lower the replacement piping into position (into the trench and onto the new pipe bedding; aligned and centred with respect to the adapters); see Figure 4-1 for pipe bedding choices. Ensure that the gap between the components are within manufactured tolerances. If the repair piping does not fit easily between the adapters, with the correct gaps, remove the replacement piping from the trench and cut to suit (and grind smooth and recoat). ***Do not force the replacement piping into the space between the adapters***, as this can damage the upstream and/or downstream piping.
27. Position one of the couplings (at the interface of an adapter and the replacement piping) as per manufacturer's instructions; tighten the coupling bolts to half of the specified torque.
28. Deflect the bell-and-spigot joint and/or the coupling (by moving the steel pipe) to match or approach the original/required pipe alignment. Each coupling should have approximately 4 degrees of available deflection, while each joint should have up to 2 degrees of available deflection.
29. Position the second coupling (at the interface of the other adapter and the other end of the replacement piping) as per manufacturer's instructions; tighten the coupling bolts on both couplings (on both ends of the steel piping) to the final specified torque. ***Do not fully tighten one end's coupling prior to having the opposite end's coupling bolted and positioned correctly***.
30. Apply bonding cables/straps (for maintaining electrical continuity), if the schedule (i.e., tides) allows (if the schedule does not allow, this can be done at a later date).
31. Apply Denso paste/mastic/tape.
32. Backfill with clear crush or granular pipe bedding (see Figure 4-1 for pipe bedding choices and other details), wrapped in fabric, to the top of the pipe and stop.
33. Bring the pump stations and force mains back into service and conduct visual inspection from outside of trench ensure that there are no leaks or other issues.
34. Continue backfilling and restore the ground surface to its original condition (see Figure 4-1).
35. Demobilize.

Replacement 2: Replacement of Two (2) Adjacent Lengths of Pipe

Follow the same steps as Replacement 1 (replacement of one length of pipe), with the following changes:

1. Two pipe sections will need to be exposed, including their bell and spigot joints.
2. Two lengthwise trench shields will be required for the replacement of two pipe sections.

3. More than one replacement steel pipe section may be required to bridge the gap. In that case, only one of the two replacement steel pipe sections will likely require cutting, and an extra coupling will be required to connect the two replacement steel pipe sections; sequentially (left to right, or right to left) position and tighten the couplings (do not fully tighten one end's coupling prior to having the other couplings bolted and positioned correctly).

Replacement 3: Replacement of One (1) Length of Pipe and One (1) Pipe Bend (Elbow)

Follow the same steps as Replacement 1 (replacement of one length of pipe), with the following changes:

1. A pipe section and an elbow will need to be exposed, including their bell and spigot joints.
2. Two lengthwise trench shields may be required for the replacement work.
3. The original elbow will be replaced with one or two new elbow(s). Bends between ~7 degrees and ~16 degrees can be accommodated by one 11.25-degree BWP elbow and the flex available in the bell/spigot joints combined with the flex available in the straight replacement pipe's couplings. Bends between ~17 degrees and ~28 degrees can be accommodated by two back-to-back 11.25-degree elbows and the flex available in the bell/spigot joints combined with the flex available in the straight replacement pipe's couplings. the flex available in the bell/spigot joints combined with the flex available in the coupling(s).
4. In the unlikely scenario where a bend greater than 28 degrees is required, or if a Y or a Tee is required, it will need to be manufactured (i.e., cutting, welding) from the Tee section of one of the replacement steel pipes, along with couplings and adapters as needed.
5. If two 11.25-degree BWP elbows are being used back-to-back, their installed length may be greater than the elbow that they are replacing. Thus, the alignment of the straight replacement steel pipe section may differ slightly from the section it is replacing; however, this difference should be capable of being accommodated by the flex available in the bell/spigot joints combined with the flex available in the straight replacement pipe's couplings. If the additional installed length cannot be accommodated within the various components' flex, then the pipe on the other side of the pipe bend that is being replaced will also need to be replaced (the replacement steel pipe would then be cut to make up for the longer installed length of the new pipe bends).
6. After the installation of the new elbow(s), install the applicable bell-to-plain steel end adapter and install the applicable spigot-to-plain steel end adapter (one will go on a new elbow and the other will go on the existing piping); at this point, measure the remaining distance between the two adapters and cut the replacement steel piping as per the Replacement 1 steps.
7. For bends greater than 5 degrees, a concrete thrust block may need to be installed against the native ground along the deflected pipe area. Due to the short pump station shut-down periods and/or tide schedules, a traditional cast-in-place thrust block will likely not be possible, and Lock-Block-type pre-cast concrete blocks will likely need to be used in conjunction with wood-based formwork and rapid-hardening repair mortar to fill in the gaps; consult with a qualified Professional Engineer for arrangement and details.
8. In the case of a vertical bend, repairs are to progress from the lower section to the higher section. This is to ensure fittings maintain their insertion depth throughout the torqueing and repair process.

4.3 CLOSE-OUT

4.3.1 Notifications/Paperwork

Once the source of the spill has been remedied (i.e., piping has been repaired and/or replaced), the parties that were notified when this spill was discovered (see Section 3) should be again contacted to let them know that the spill's source has been contained. Follow the recommendations from the federal, provincial, and municipal environmental organizations that have been contacted (i.e., required remediation, further monitoring and reporting).

4.3.2 Replacement Materials Renewal & Labelling

Any Replacement Materials that have been mobilized and/or utilized in repairs and replacement work should be re-ordered (if applicable), relabeled (if applicable), and returned to their designated storage spaces.

4.3.3 Inventory Update

When waiting for new Replacement Materials to be manufactured or delivered, a temporary Inventory Table (noting the missing items) should be used. As soon as the new Replacement Materials have been delivered, they should be labeled in the same manner as the materials that they are replacing were labeled. In addition, the temporary Inventory Table should be discarded and the original Inventory Table should be put back in use.

References

Canadian Union of Public Employees. 2015. Wastewater Treatment Plant Occupational Health and Safety Bulletin. On-line at http://www.cupe.bc.ca/committees/occupational-health-and-safety

Work Safe BC. 2016. Part 20 Construction, Excavation and Demolition
Online at https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-regulation/part-20-construction-excavation-and-demolition

BC OneCall
Online at http://www.bconecall.bc.ca/about-WhyCall.php

Pacific Flow Control
Online at http://www.pacificflowcontrol.ca/

Certification Page

This report presents a Spill Response Plan for the Comox Valley Regional District's Hyprescon wastewater force mains.

Respectfully submitted,

Prepared by:

Deryck Irmen, GradTech
Civil Technologist

Reviewed by:

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
L. R. MARTIN

April 5, 2017

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
L. MARMOLEJO
29424

Apr. 5/17

Leif Marmolejo, M.Eng., P.Eng.
Manager – Wastewater

Larry Martin, P.Eng.
Manager – Regional Infrastructure

Hugh Hamilton, Ph.D., P.Ag.
Corporate Environmental Science Specialist

DI/LM/HH/LM/lp

Appendix A - Training

1. Training Approach

All CVRD personnel that may be involved with responding to a wastewater force main spill, from decision makers to field personnel, should become familiar with the Spill Response Plan and the related Replacement Materials. In addition, CVRD personnel should strive to review the document at least annually, and update its contents as necessary (i.e., Inventory of Replacement Materials, contact information for notifications and contractors).

To facilitate the annual review of the Spill Response Plan, it is suggested that any potential spill response personnel participate in annual training sessions/refreshers; the PowerPoint presentation that has been included in this appendix has been developed for this purpose, and is available in electronic formats (i.e., *.ppt and *.pdf). It is further suggested that the presentation be followed by a walkthrough of the storage area where the Replacement Materials are kept, with the trainer pointing out the key items.

2. Materials and Presentation

The PowerPoint presentation that has been included in this appendix is available in electronic formats (i.e., *.ppt and *.pdf); hard copies can be printed for trainees to write notes on.

Associated Engineering

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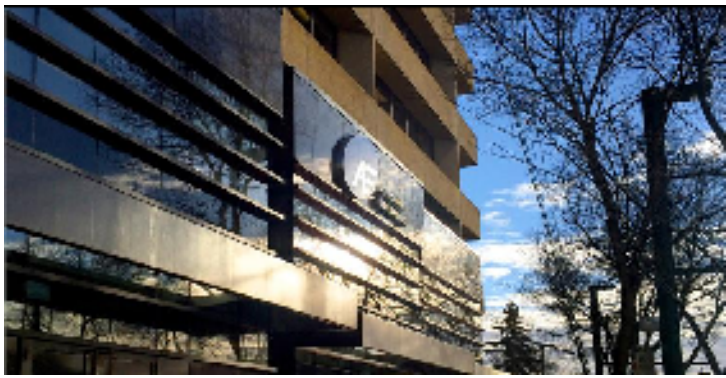


CVRD - Spill Response Plan

Pump Station Hyprescon Force Mains

April 5, 2017

Agenda

1. Background / Upgrade Options
2. Spill Scenarios
3. Regulatory Compliance and Notifications
4. Spill Response Steps
5. Repair Methodology
6. Close-out

Background - Purpose

- Provide the CVRD with a tool to respond to a failure in the wastewater force mains
- Minimize downtime of system by minimizing repair time
- Minimize the amount of wastewater discharged into environment

Background

- Installed in the early 80s
- Prestressed Concrete Cylinder Pipe (PCCP)
  - 750-mm diameter from Courtenay PS to Jane Street junction
- Bar-Wrapped Pipe (BWP)
  - 450-mm diameter from Jane Street PS to junction
  - 820-mm diameter from junction to CVWPCC
- Outfall force main is 900-mm-diameter PCCP; not in scope
- Original manufacturer was Hyprescon, now Forterra

Background

Prestressed Concrete Cylinder Pipe (PCCP)

- Follows AWWA Standard C301
- Contains a steel cylinder that functions as watertight conveyance for liquid
- High-strength steel wires wrapped under tension provide strength
- Internal concrete lining and external mortar coating protecting the steel

Background

Bar-Wrapped Pipe (BWP)

- Follows AWWA Standard C303
- Contains a steel cylinder that functions as watertight conveyance for liquid
- Mild steel reinforcing bars wrapped under tension provide strength
- Internal concrete lining and external mortar coating protecting the steel

Background

- Force main has been protected by an impressed-current cathodic protection (ICCP) system and anode beds
- Piping may not be fully protected as bonding straps at joints may be broken or damaged
- Severe operational conditions: raw wastewater inside and, in some areas, marine environment outside
- Wide range of failure possibilities

Background

- Different failure modes:
  - Failure from corrosion of mild steel cylinder and/or bars
  - Failure from deterioration of concrete matrix
  - Failure in joint due to corrosion, deterioration, pressure spike

- Resulting in:
  - Minor leak,
  - Significant break, or
  - Anything in between

Background - Relevant Documents

- Spill Response Plan
- Wastewater Force Main Drawings (Courtenay Pump Station to Goose Spit): alignments, plans and sections
- Wastewater Force Main Drawings (Goose Spit to the CVWPCC): alignments, plans and sections

Background - Relevant Documents (cont'd)

- Wastewater Force Main Sketches and List of Components (Contract S-5: Courtenay Pump Station to Goose Spit)
- Wastewater Force Main Sketches and List of Components (Contract S-7: Goose Spit to the CVWPCC)
- Wastewater Force Main Shop Drawings (Contract S-7: Goose Spit to the CVWPCC)
- Inventory of Aging Replacement Materials Stocked by the CVRD at the CVWPCC

Background - Limitations

- Limited options in design for bypassing flow
- Minimal storage available in the wet wells and upstream sanitary sewers, limited time period to shut down force mains
- Significant time to locate and repair a failure
- Likely stay in operation until leak is located, repair materials/equipment/personnel on site and ready
- Spill Response Plan does not cover the outfall gravity/force main (900-mm-diameter PCCP), but is useful

Permanent Upgrade Options to consider

- Upgrades to consider in certain locations:
  - Addition of tees for future bypass piping, blinded for future use.
  - Addition of block valves in areas lacking

(Forterra, 2017)

- Can be accomplished by Hot Tapping, Line Stopping and Valve Inserts; however, expensive and risky (could damage piping)

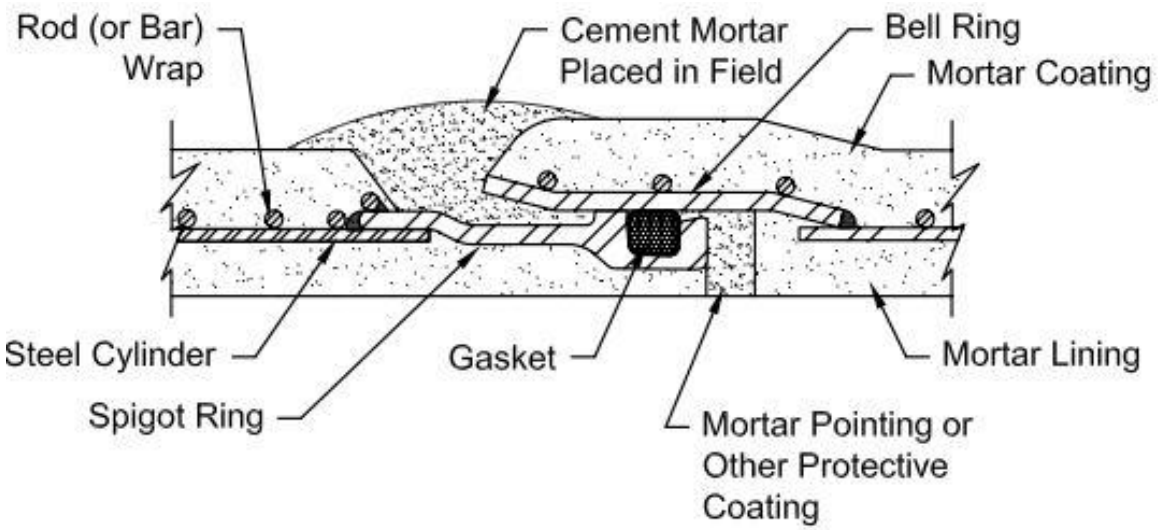
Spill Scenarios

Most Common Failure Types for PCCP/BWP class pipes:

- Failure Type A: Corrosion of the mild steel cylinder and/or mild steel bars

Spill Scenarios

- Failure Type B: Bell/Spigot joint Failure



Spill Scenarios

- Failure Type C: Catastrophic Failure (from water hammer or other pressure spikes)
  - Could occur at Type A and Type B weak points

Location Types

Location Type A: Land, Roads

- Likely least demanding

(Google Maps, 2017)

Location Types

Location Type B: Tidal

- Difficult location
- Environmental impacts
- Deployment issues
- Dewatering
- Tidal fluctuations

(Google Maps, 2017)

Location Types

Location Type C: Goose Spit Bay

- Most difficult
- Adverse ground conditions
- Same considerations as Type B

(Google Maps, 2017)

Regulatory Compliance and Notifications

- Federal, provincial and municipal environmental regulations
  - Canadian Environmental Protection Act (CEPA) – Environment and Climate Change Canada
  - Fisheries Act – Canada Coast Guard/Fisheries and Oceans Canada (DFO) and Environment Canada
  - Migratory Bird Convention Act - Environment Canada
  - Environmental Management Act – BC Ministry of Environment
  - WorkSafeBC
  - Vancouver Island Health Authority

Regulatory Compliance and Notifications (cont'd)

- Comox Valley Regional District
- Town of Comox
- City of Courtenay
- K'omoks First Nation

Mandatory Environmental Notifications

- BC Ministry of Environment (MoE)/Provincial Emergency Program (PEP)
  - primary point of contact for spills or other accidental releases of contaminants
  - Spill Reporting Regulations of the BC Environmental Management Act
  - Schedule No. 24 – “a substance that can cause pollution”
  - requires reporting is 200 liters (0.2 cubic meters) or 200 kg
  - Reporting must occur immediately
  - contact telephone number is 1-800-663-3456

Mandatory Environmental Notifications

A reporting template, Environmental Incident Form (see Table 3-2)

Table 3-2
Environmental Incident Form (expand/customize if needed)

Date of Incident: _____	Time of Incident:	AM ☐ PM ☐
Name and contact of person that discovered incident:		
Name and contact of person that caused incident:		
Location of incident (include landmarks and features, nearest cross street, pipe type/size):		
Extent of incident (provide a sketch if necessary):		
Quantity or volume of material incident:		
Estimate of distance to nearest waterway (including stormwater drains and dry watercourse):		
Type of activity that caused the incident (works in progress at time of Incident):		
Name of people on scene of incident:		
Level of incident:		
☐ Minor	e.g.no material has escaped the site or caused material to harm the environment. It is easy to clean up without additional assistance.	
☐ Major	e.g. material has escaped site causing pollution of downstream areas which will require clean up involving other agencies or resources. Review *Environmental Management Act* for details on spill reporting quantities.	
Incident Commander:		
Lead Agency:		
Name of agencies or other persons advised of the spill:		
Any other details of the incident:		
Corrective action taken:		

Mandatory Environmental Notifications

- Marine pollution incidents:
  - Canadian Coast Guard (Fisheries and Oceans Canada)
    - contact number for BC is 1-800-889-8852 (24 hours)
  - Environment and Climate Change Canada
    - Covered by the above MoE/Provincial Emergency Program
  - Fisheries and Oceans Canada
    - Covered by the above MoE/Provincial Emergency Program

WorkSafeBC Notification

- Use same 200 liter threshold
- Is necessary, if CVRD personnel or contractors are involved in any spill control and clean-up

Other Recommended Notifications

- Vancouver Island Health Authority (VIHA)
- K'omoks First Nation, Public, Industry
- See Table 3-1

Table 3-1
Emergency Spill Notification Contacts

Contact Name	Contact Number	Mandatory Contact (Y/N)
MANDATORY		
Environmental Emergency Reporting (BC MoE & Environment Canada)	1-800-663-3456	Y
Canadian Coast Guard 24-hour marine spill reporting	1-800-889-8852	Y
WorkSafeBC 24-hour Worksite Emergency Reporting	1-888-621-7233	Y
NON-MANDATORY, BUT RECOMMENDED		
BC Ministry of Environment (MoE), Environmental Protection Division – Nanaimo (to supplement Environmental Emergency Reporting - above)	250-751-3100	N
Vancouver Island Health Authority Health Protection and Environmental Services, Comox Valley	250-331-8518	N
K'omoks First Nation	250-339-4545	N
City of Courtenay, Public Works	250-338-1525 or 250-334-2947	N
Town of Comox, Public Works	250-339-5410	N
CHEK News	250-480-3700	N
Comox Valley Echo Newspaper	250-334-4722	N
Comox Valley Record Newspaper	250-338-5811	N
97.3 The Eagle Radio	250-703-0199	N
98.9 The Goat Radio	250-334-2421	N
Project Watershed Society	250-703-2871	N
BC Shellfish Growers Association	250-890-7563	N
First Nation Fisheries Council	778-379-6470	N
Department of National Defense/CFB Comox	250-339-8211	N

Health & Safety Requirements

- Same practices that apply to workers in wastewater treatment facilities in British Columbia; see Section 3.4 and Appendix F

- Ensure that all WorkSafeBC requirements are followed throughout the duration of all spill control, containment, and cleanup activities.
- Ensure that all workers are aware of the hazards associated with working with untreated municipal wastewater (sewage). A daily "tailgate meeting" should be held prior to beginning work to review and health and safety procedures.
- Use appropriate protective clothing at all times (i.e., liquid-repellent coveralls) and personal protective equipment (PPE – rubber boots, rubber gloves, plastic face shields) and, where required, wear respiratory protective equipment.
- Avoid direct contact with sewage.
- Avoid aerosolizing sewage water, or minimize exposure time in areas where aerosolizing is occurring. If working in a confined space, make sure ventilation systems are functioning properly when working around areas where sewage may be aerosolized.
- Thoroughly cleanse all exposed injuries with soap and water and keep them covered with a bandage (preferably waterproof) while at work. Seek medication attention immediately after suffering cuts or penetrating injuries.
- If a worker is suffering from a skin problem, they should see a physician to secure clearance before working with sewage.
- Avoid touching the face, mouth, hands, eyes or nose with dirty hands or other items and avoid nail biting.
- Thoroughly wash the hands and face with soap and water before eating, drinking or smoking.
- Eat or smoke in designated areas away from sewage contamination. These areas must be kept free from contamination by leaving any protective clothing and boots in a separate area, for example.
- Remove personal protective clothing and footwear at the end of the shift and leave it at work. Dispose of any disposable PPE is the proper container.
- Shower and change out of work clothes before leaving work.
- Report any damaged equipment.
- Report all work-related symptoms to the employer and the physician. These may include:
  - cramping stomach pains, diarrhea, vomiting;
  - yellowing of the skin;
  - symptoms of breathlessness, chest tightness and wheezing;
  - redness and pain of the eyes; and
  - skin rash and/or pain.

Spill Response Steps

- Identify, Confirm and Document the spill
  - Minor Leaks
    - Likely hard to identify
    - Damp odorous ground conditions
  - Major Leaks
    - Significant amount of leakage, sighted by someone (public)
    - Unexpected pressure drop?
    - Decrease in flow to treatment plant?
  - Fill Environmental Incident Form, Table 3-2 (leave missing info blank)

Steps - Notifications and Initiation of the Response

- Notify appropriate CVRD personnel ASAP (listed in Table 4-1)

Table 4-1
CVRD Notifications

Name	Title	Office phone	Cell phone	Alternate
Mike Imrie	MGR Wastewater Services	250 339 5231	250 218 2924	Mark Zanders
Kris LaRose	Senior Manager of Water/Waste	250 334 6083	250 218 6689	Mike Imrie
Marc Rutten	GM of Engineering Services	250 334 6080	250 703 3166	Kris LaRose
Mark Zanders	Chief Operator	250 339 5231	250 941 2659	
Howie Siemens	CV Emergency program coordinator	250 334 8890	250 334 6488	
Russell Dyson	Chief Administration Officer	250 334 6055		Mark Rutten

Steps - Notifications and Initiation of the Response

- CVRD to notify all mandatory organizations identified in section 3.1
- Initial Spill Response Meeting
    - Assign Incident Commander
    - Go over steps and identify outside help
    - Identity further (non-mandatory) notifications
    - Delegate tasks

Steps - Notifications and Initiation of the Response

- Carry out non-mandatory notifications
- Contact contractors and consultants (listed in Table 4-2)

Table 4-2
Contractors and Consultants

Hydrovac/Pumper Services	Civil Contractors	Engineering Consultants
Badger Daylighting 778 585 0091 Jay Love 24 hr. contact 250 618 3252	JR Edgett Excavating 250 339 6100 Bruce Henderson 24 hr. contact 250 703 3787	Associated Engineering 604 293 1411 Leif Marmolejo, Tom Robinson, Deryck Irmen
Walco Industries 1 888 599 2526 Charlie Walcot 24 hr. contact 250 203 4742	Wacor Holdings 250 287 9644 Dave Atkinson 24 hr. contact 250 287 4742	
Wacor Holdings 250 287 9644 Dave Atkinson 24 hr. contact 250 287 4742	Leighton Excavating 250 338 6460 Robert Leighton 24 hr. contact 250 898 3012	
	Ridgeline Contracting Garth O'Neil 24 hr. contact 250 898 7648	

Steps - Excavation

- Secure the site
- Attempt to contain, collect and truck leakage
- Contact BC One Call prior to any excavation
- Contact utility-locating company (if required)
- Follow proper daylighting/hydrovac'ing techniques to expose utilities and to expose leaking area of pipe, per OSHR Part 20.79

Steps - Determine Failure Details and Plan the Repair

- Carry out spill site visit
- Again, attempt to contain, collect, truck the leaking wastewater
- Fill out an Emergency Repair Questionnaire (ERQ), to determine failure type
- Distribute ERQ and filled Incident Form to all parties
- Carry out a Repair Planning Meeting to determine Repair Methodology

Repair Methodologies

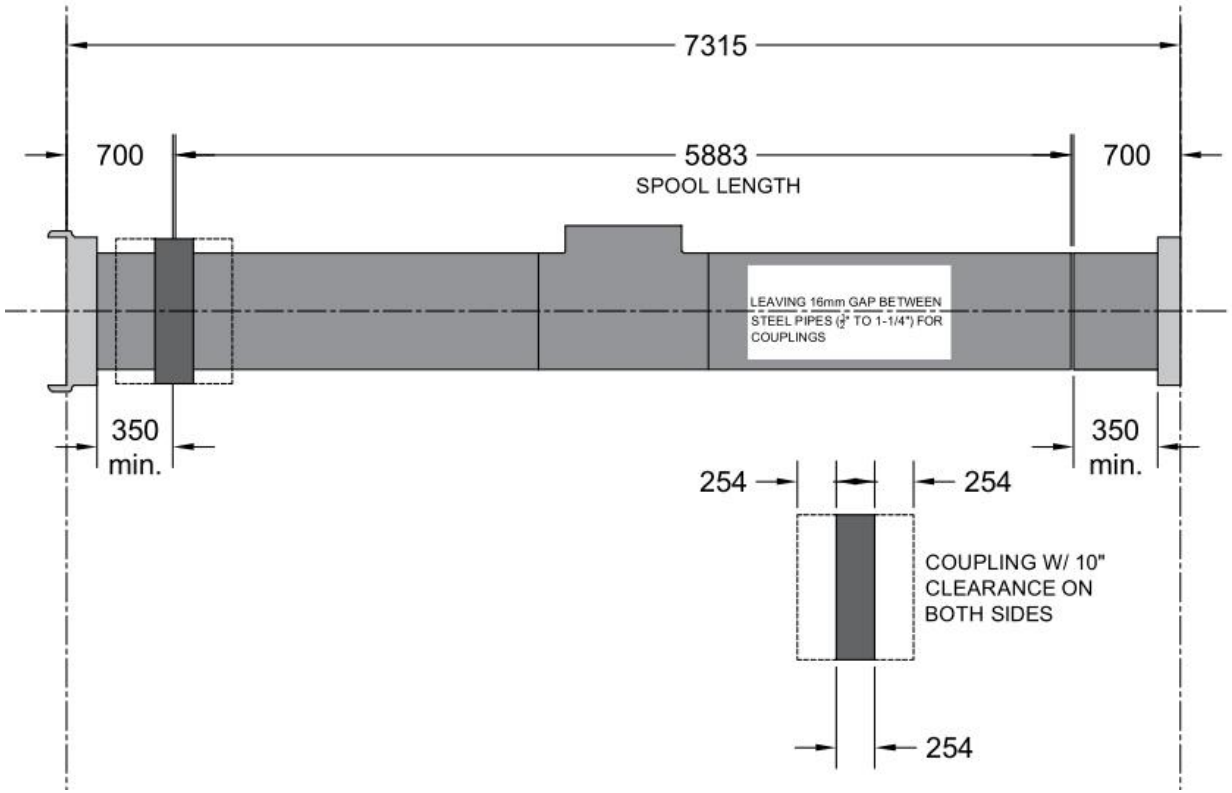
- Minor Leaks
  - Where pipe is repairable
  - Labour requirements (see Section 4.3.2.1 of report)
  - Equipment requirements (see Section 4.3.2.2)
  - Repair procedures by Forterra (1st document in Appendix E)
- Major Leaks (Replacement of Piping Components)
  - Labour requirements (see Section 4.3.2.1 of report)
  - Equipment requirements (see Section 4.3.2.2)
  - Replacement Materials (see Section 4.3.2.3)
  - Installation instructions by Forterra (2nd document in Appendix E)

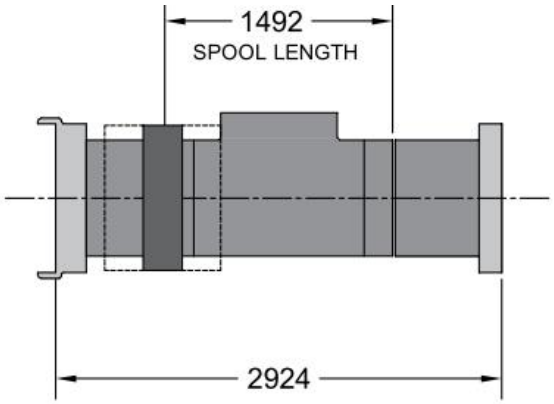
Repair Methodologies

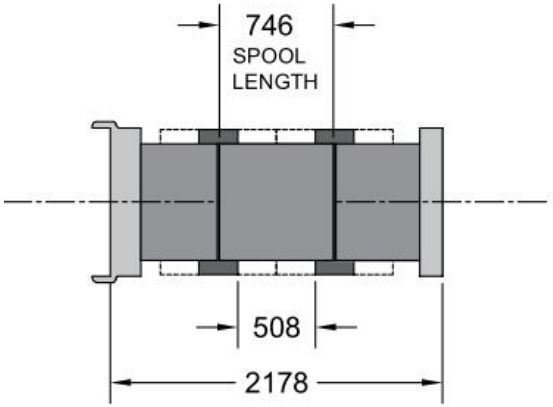
- Three Main Replacement Scenarios:

1. Replacement of 1 length of pipe
2. Replacement of 2 lengths of pipe
3. Replacement of 1 length of pipe and 1 elbow

Repair Methodologies







Repair Methodologies

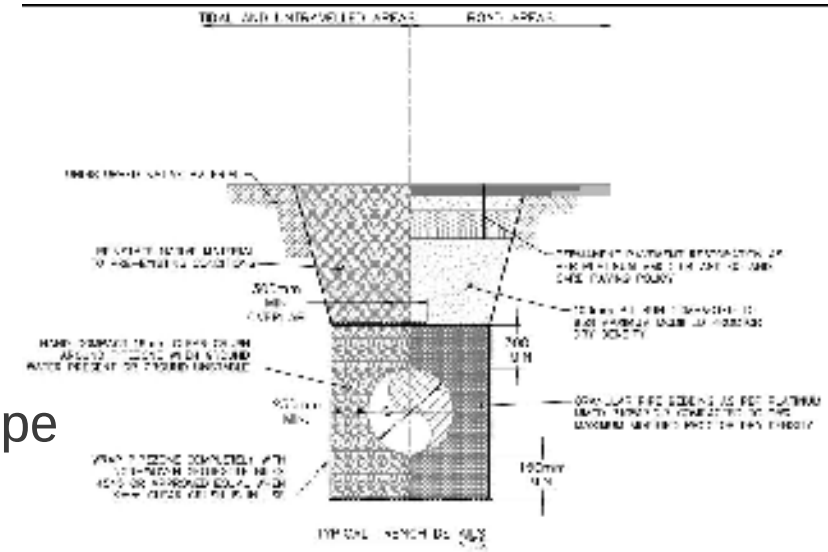
- Replacement 1 (1 length of pipe):
  - Assess spill location
  - Implement traffic control plan
  - Enter work area and initiate excavation
  - Use hydrovac truck within 1 meter of pipe
  - Assess pipe failure and adjust repair plans if necessary
  - Shut down/lock down Courtenay and Jane Street pump stations
  - Isolate failed section of pipe
  - Expose full section of pipe to their joints
  - Install steel protective trench shields

Repair Methodologies

- Replacement 1 (cont'd):
  - Use inflatable plugs at the nearest upstream and downstream access hatches
  - Add drain point(s), if required (follow Appendix E)
  - Drain isolated portion of pipe (using pumper trucks, if possible)
  - Cut and remove 3m section of pipe
  - Remove bell and spigot joints carefully
  - Inspect remaining portions of pipe and joints for damage
  - Over-excavate, new bedding for new pipe
  - Clean joint ends and add new gasket

Repair Methodologies

- Replacement 1 (cont'd):
  - Install bell/spigot to plain steel adaptor fittings to each end
  - Measure and cut remaining portion for steel pipe
  - Slide Robar 1906 coupling to each side
  - Place steel pipe between adaptors
  - Position couplings over pipe and tighten to spec.
  - Backfill
  - Restart pump stations and conduct visual inspection
  - Continue backfill and demobilize



Repair Methodologies

- Replacement 2 (2 lengths of pipe):
  - Same as Replacement 1 except the following:
  - Expose 2 consecutive sections of pipe including adjacent joints
  - Use two lengthwise trench shields
  - Two lengths of steel pipe and additional coupling may be required

Repair Methodologies

FIGURE C-1

REPLACEMENT #1:
REPLACEMENT OF ONE (1) LENGTH OF PIPE (N.T.S.)

1. IDENTIFY LOCATION OF LEAK

2. REMOVE ONE (1) DAMAGED PIPE AND PREPARE BASE

3. INSTALL BELL X PLAIN STEEL END ADAPTER AND SPIGOT X PLAIN STEEL END ADAPTER TO EXISTING BAR WRAPPED PIPE

4. SLIDE COMPRESSION COUPLINGS ON TO PLAIN END STEEL PIPE AND CUT LENGTH OF STEEL TO SUIT REPAIR

5. ALIGN STEEL PIPE AND SLIDE COMPRESSION COUPLINGS INTO POSITION

6. TIGHTEN COMPRESSION COUPLINGS TO MANUFACTURER'S SPEC'D TORQUE

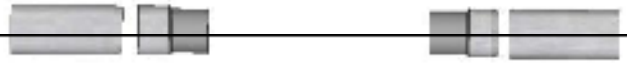
FIGURE C-2

REPLACEMENT #2:
REPLACEMENT OF TWO (2) ADJACENT LENGTHS OF PIPE (N.T.S.)

1. IDENTIFY LOCATION OF LEAK

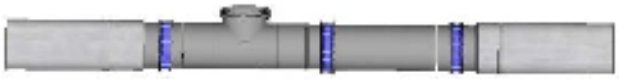
2. REMOVE TWO (2) DAMAGED PIPES AND PREPARE BASE

3. INSTALL BELL X PLAIN STEEL END ADAPTER AND SPIGOT X PLAIN STEEL END ADAPTER TO EXISTING BAR WRAPPED PIPE

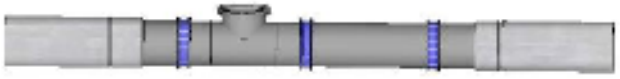


4. SLIDE COMPRESSION COUPLINGS ON TO PLAIN END STEEL PIPE AND CUT LENGTH OF STEEL TO SUIT REPAIR

5. ALIGN STEEL PIPE AND SLIDE COMPRESSION COUPLINGS IN TO POSITION



6. TIGHTEN COMPRESSION COUPLINGS TO MANUFACTURER'S SPEC'D TORQUE

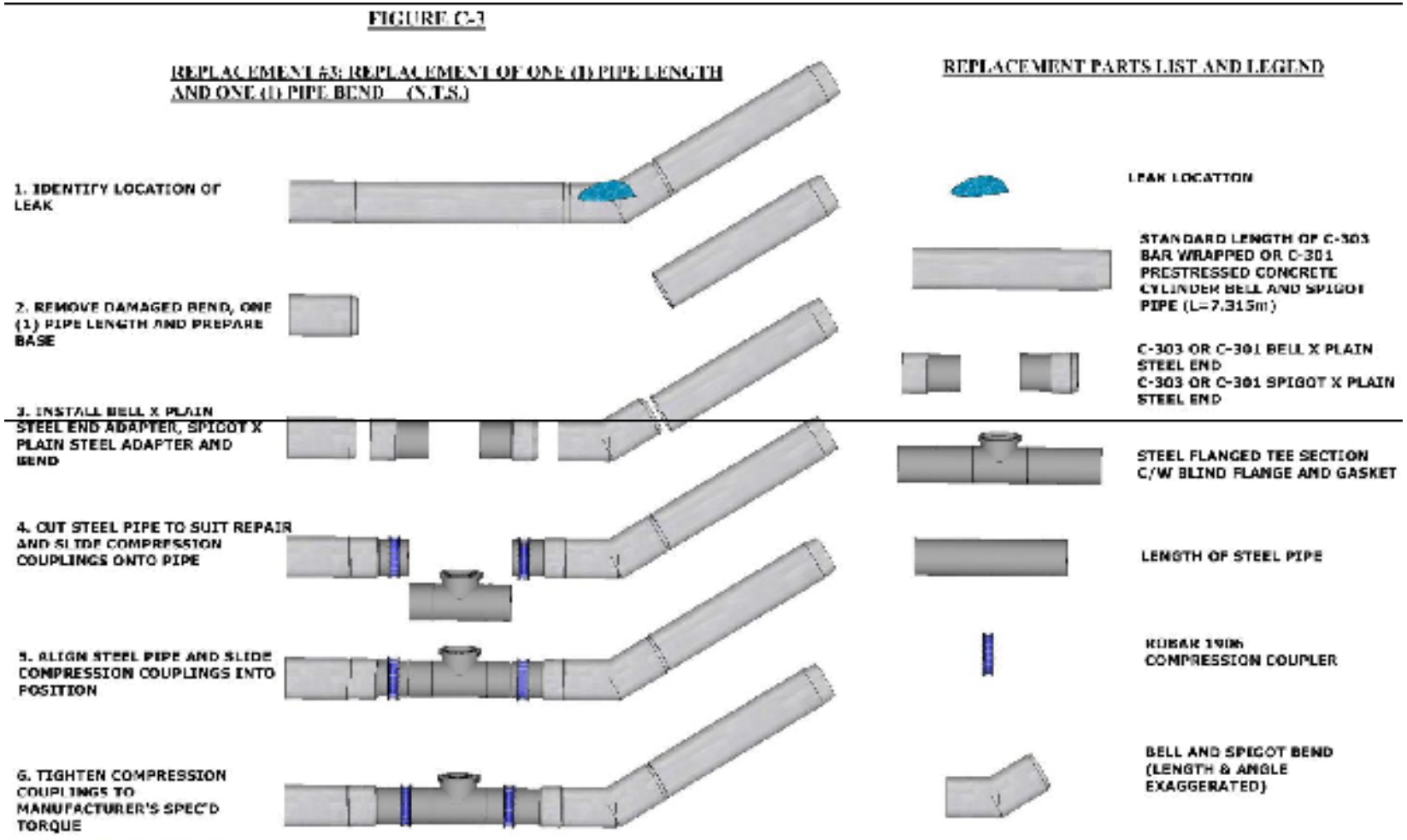


Repair Methodologies

- Replacement 3 (1 length of pipe and 1 pipe bend):

  - Same as Replacement 1 except the following:
  - Expose 1 pipe section and 1 elbow including adjacent joints
  - Original bends will be replaced with 1 or more 11.25-degree elbow(s) depending on required angle
  - Anything > 28 degrees and Wye or Tee sections will be custom made from replacement steel pipe's Tee section
  - Depending on magnitude of bend, thrust blocks may be required, consult with qualified Professional Engineer

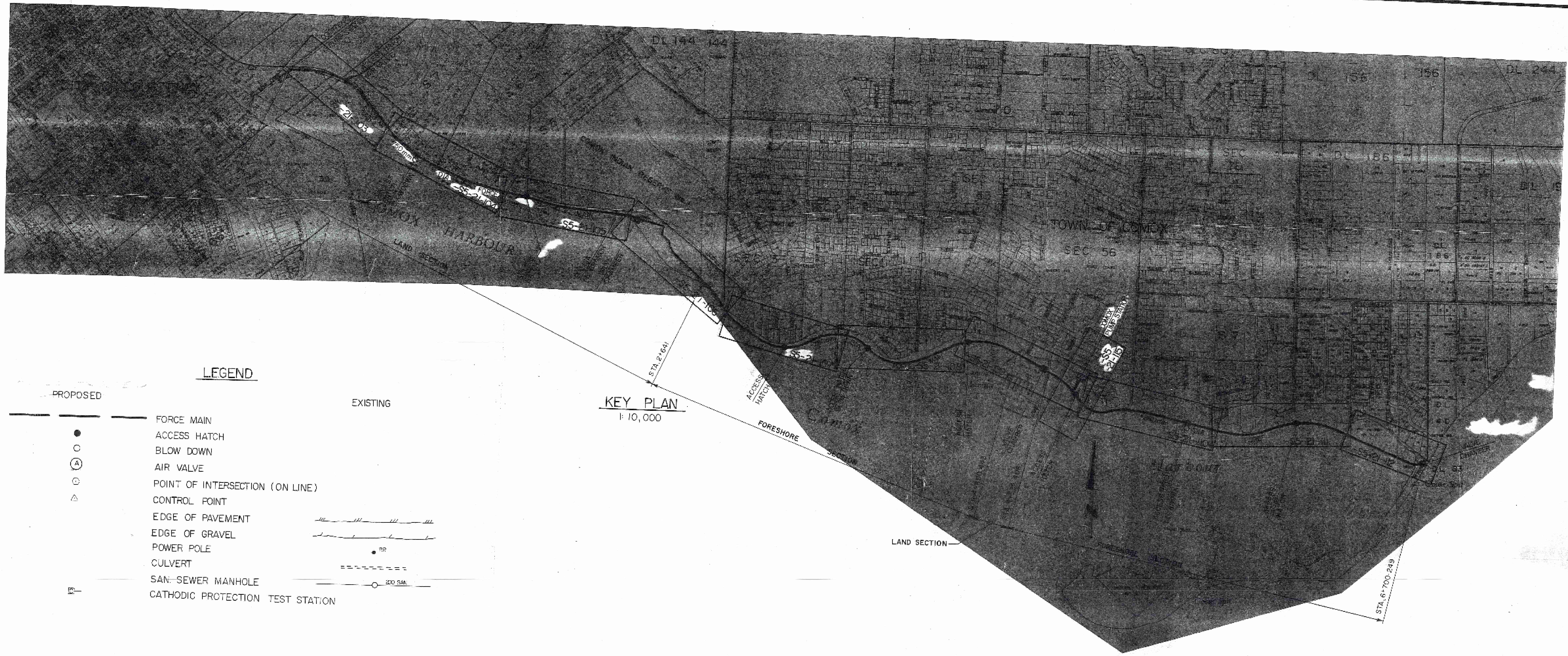
Repair Methodologies



Close-out

- Notifications/Paperwork
  - Contact and update initially notified parties
  - Follow any recommendations from parties regarding any require remediation or monitoring
- Repair Materials Replacement & Labelling
  - Re-order and replenish any used spares
- Inventory Update
  - Update inventory table temporarily while new components are on order

Appendix B - Background Documents



KEY PLAN
1: 10,000

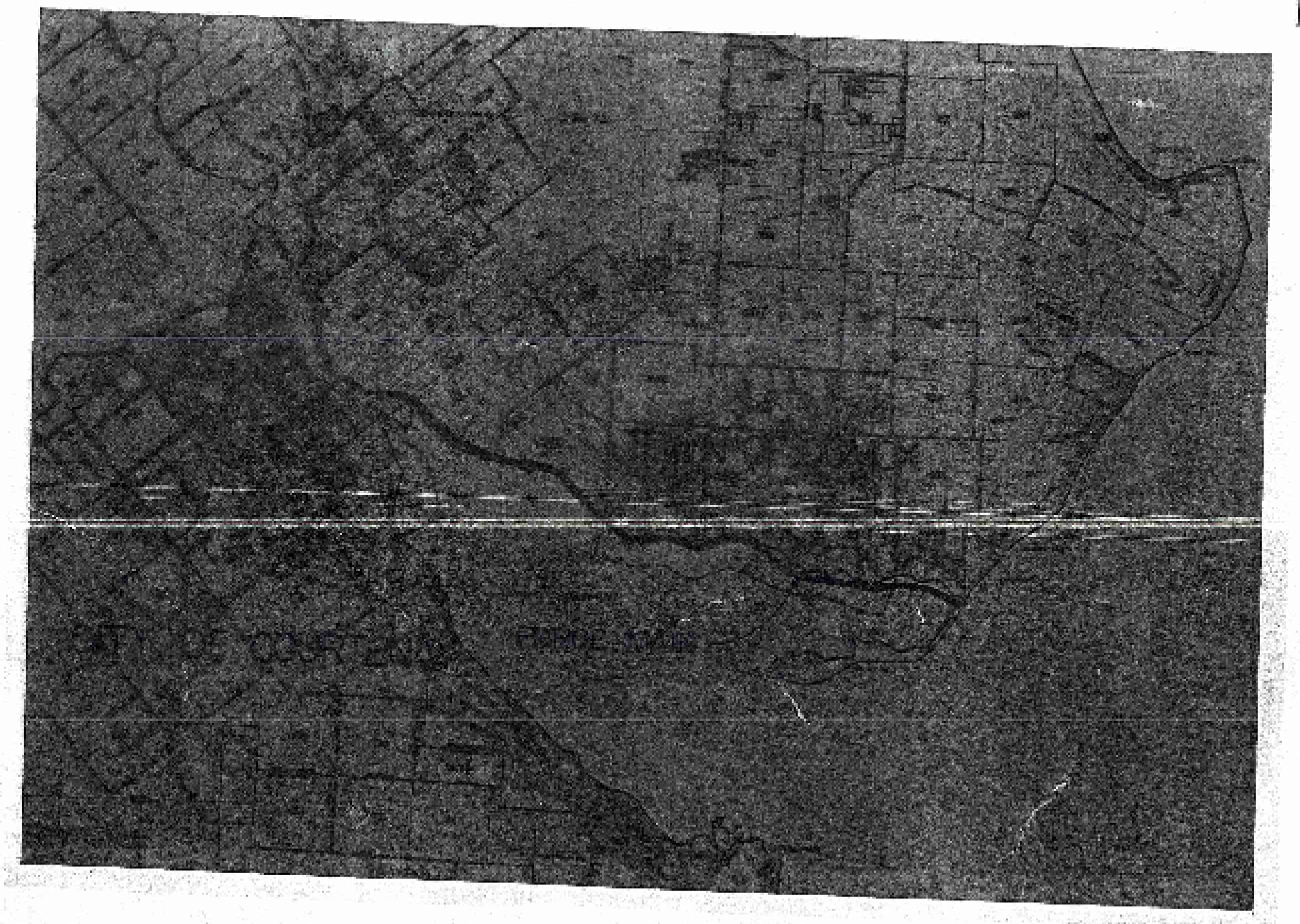
LEGEND

PROPOSED		EXISTING
— — —	FORCE MAIN	
●	ACCESS HATCH	
○	BLOW DOWN	
Ⓐ	AIR VALVE	
⊙	POINT OF INTERSECTION (ON LINE)	
△	CONTROL POINT	
	EDGE OF PAVEMENT	
	EDGE OF GRAVEL	
	POWER POLE	
	CULVERT	
	SAN. SEWER MANHOLE	
	CATHODIC PROTECTION TEST STATION	

GENERAL NOTES

1. WORKING EASEMENT WIDTHS WHERE SHOWN ARE GENERAL OUTLINES ONLY. ASCERTAIN ACTUAL WORKING BOUNDARIES AND CONDITIONS PRIOR TO CONSTRUCTION FROM THE ENGINEER.
2. AT HORIZONTAL AND VERTICAL CURVES OR DEFLECTIONS WHERE NO BEND FITTINGS ARE SPECIFIED, THEY SHALL BE FORMED BY EITHER PIPE JOINT DEFLECTION, SKEWED ENDS OR SMALL BEND FITTINGS.
3. ALL LOCATIONS OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED BY USE OF PIPE LOCATOR AND MANUAL DIGGING. ALL OR ANY EXISTING STRUCTURES NOT NECESSARILY SHOWN.
4. ELEVATIONS ARE TO GEODETIC DATUM.
5. DIMENSIONS ARE IN METRES OR MILLIMETRES UNLESS OTHERWISE SPECIFIED.
6. PIPE DIAMETERS NOTED ON THE DRAWINGS ARE NOMINAL DIAMETERS. SEE SPECIFICATIONS FOR ACTUAL DIAMETERS.
7. COORDINATES OF ALL CONTROL POINTS, AND POINTS OF INTERSECTION SHOWN ON THE DRAWINGS SHALL BE GIVEN TO THE CONTRACTOR PRIOR TO CONSTRUCTION

INDEX OF DRAWINGS



LOCATION PLAN
[illegible]

= METRIC =

NO	DATE	BY	ENG.	SUBJECT
1	JAN. '83			AS CONSTRUCTED

REVISIONS

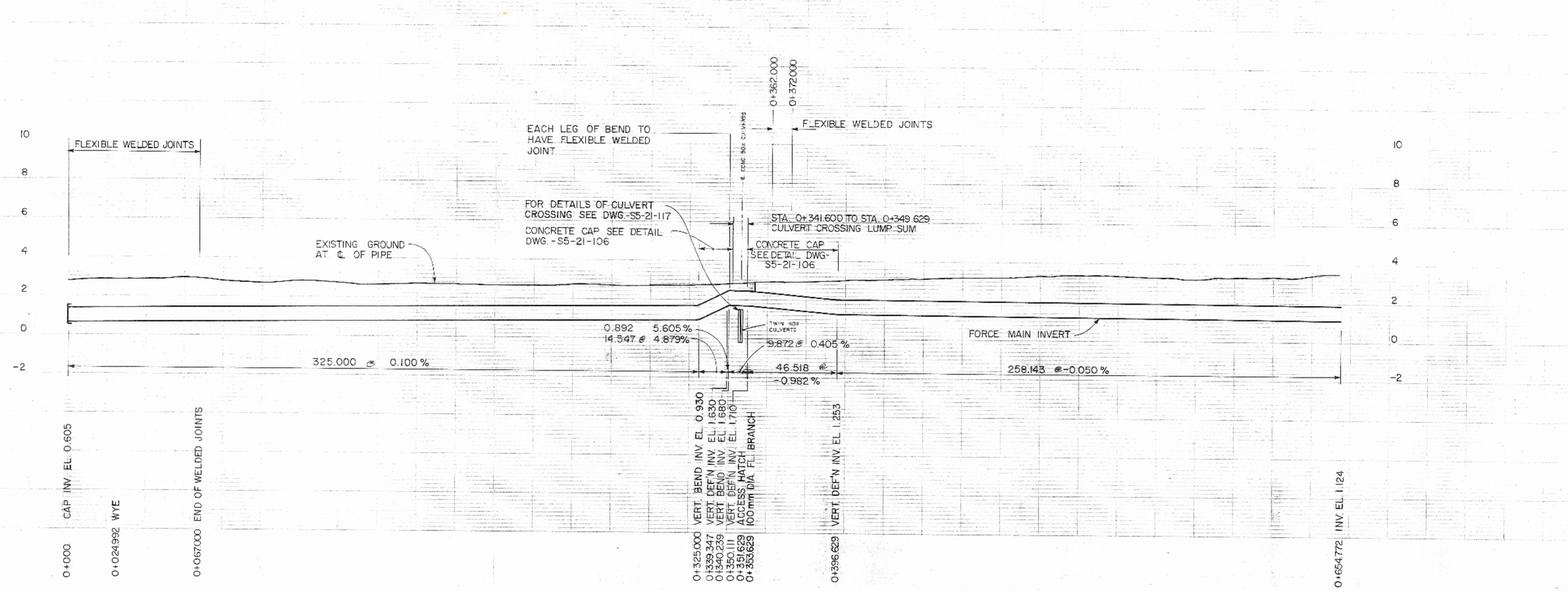
JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

KEY PLAN

DRAWING No.



ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡METRIC≡

NO	DATE	BY	ENG.	SUBJECT
2	JAN. '83			AS CONSTRUCTED
1	JUNE '82	H.B.		CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	HOR. 1:1000 VERT. 1:100
DRAWN	MB
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R. W. SHARP

REGIONAL DISTRICT OF COMOX-STRATHCONA

REGIONAL SEWERAGE SYSTEM

SEWAGE FORCE MAIN COURTENAY TO GOOSE SPIT CONTRACT S5

FORCE MAIN PLAN & PROFILE COMOX RD.

DRAWING NUMBER	REV.	SHEET
5-21-101	2	

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
2	JAN. 83			AS CONSTRUCTED
1	JUNE 82	H.B.		CONTROL ADDED

REVISIONS

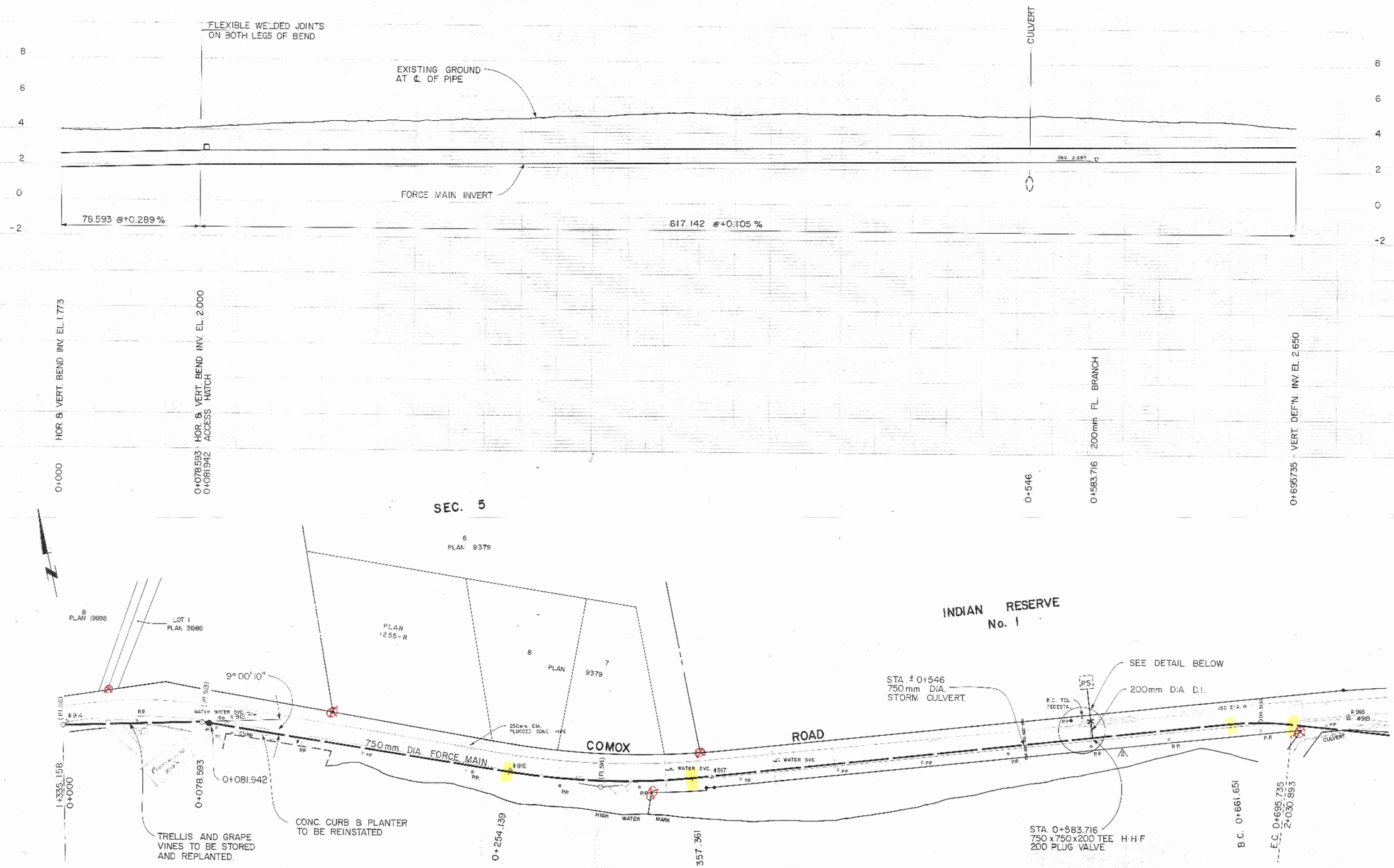
JOB NUMBER	V41E
SCALE	HOR. 1:1000 VERT. 1:100
DRAWN	HB
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA F.W. SHARP

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

PROJECT
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

SUBJECT
FORCE MAIN PLAN & PROFILE COMOX RD.



ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡METRIC≡

NO	DATE	BY	ENG.	SUBJECT
3	JAN. 83			AS CONSTRUCTED
2	AUG. '82			TEE RELOCATED
1	JUNE '82	H.S.		CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	HOR. 1:1000 VERT. 1:00
DRAWN	
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

PROFESSIONAL ENGINEER OF R. W. SHARP REGISTERED ENGINEER

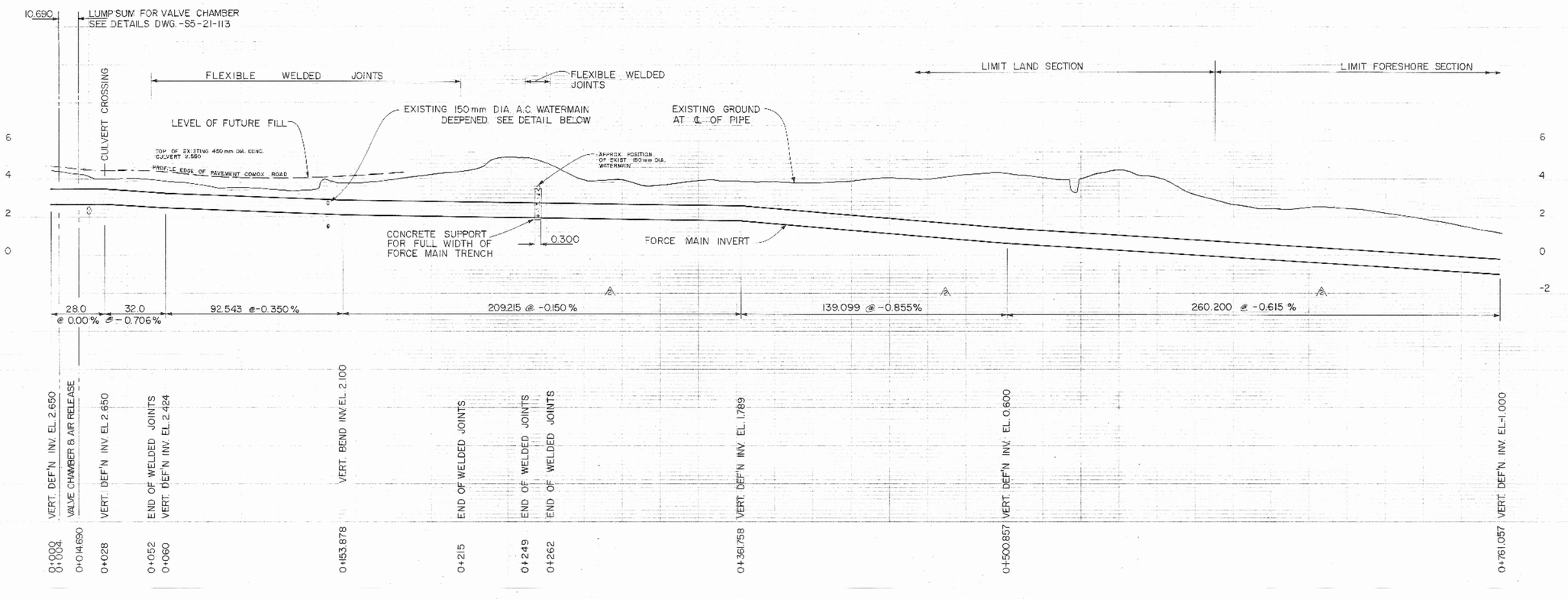
REGIONAL DISTRICT OF COMOX - STRATHCONA

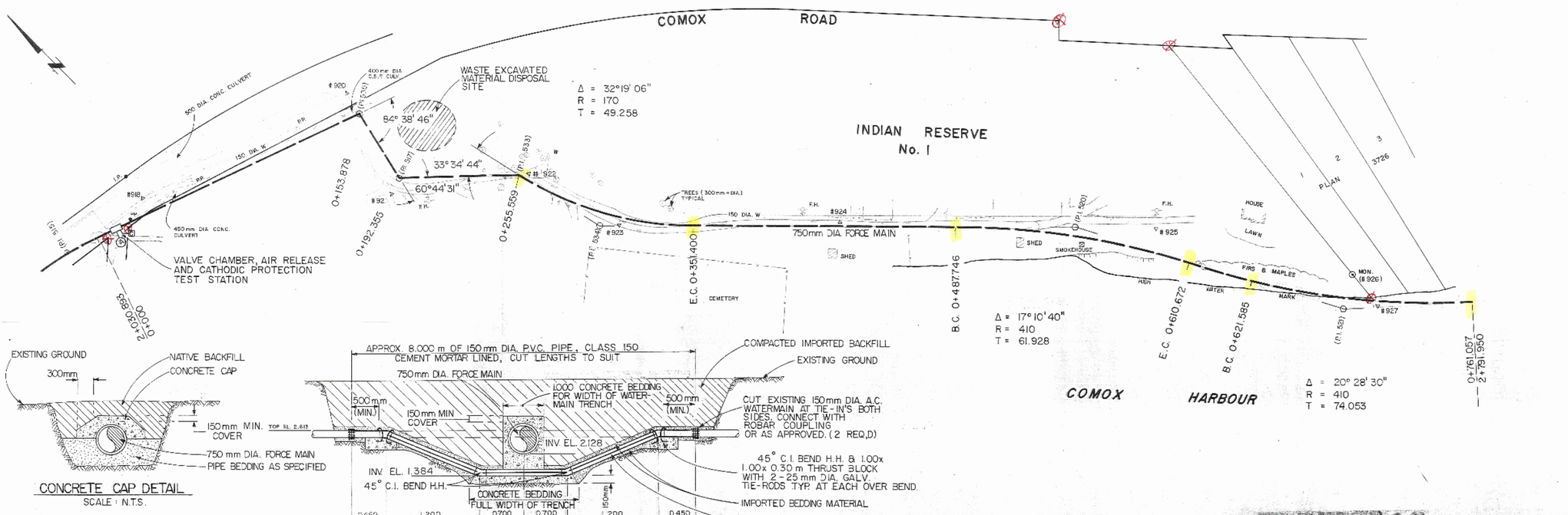
REGIONAL SEWERAGE SYSTEM

SEWAGE FORCE MAIN COURTENAY TO GOOSE SPIT CONTRACT S5

FORCE MAIN PLAN & PROFILE COMOX RD.

DRAWING NUMBER	REV	SHEET





ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡METRIC≡

NO	DATE	BY	ENG.	SUBJECT
3	JAN.'83			AS CONSTRUCTED
2	SEPT.'82			GRADE CHANGED
1	JUNE'82	H.B.		CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	HOR. 1:1000 VERT. 1:100
DRAWN	
DESIGNED	W. J. H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R. W. SHARP

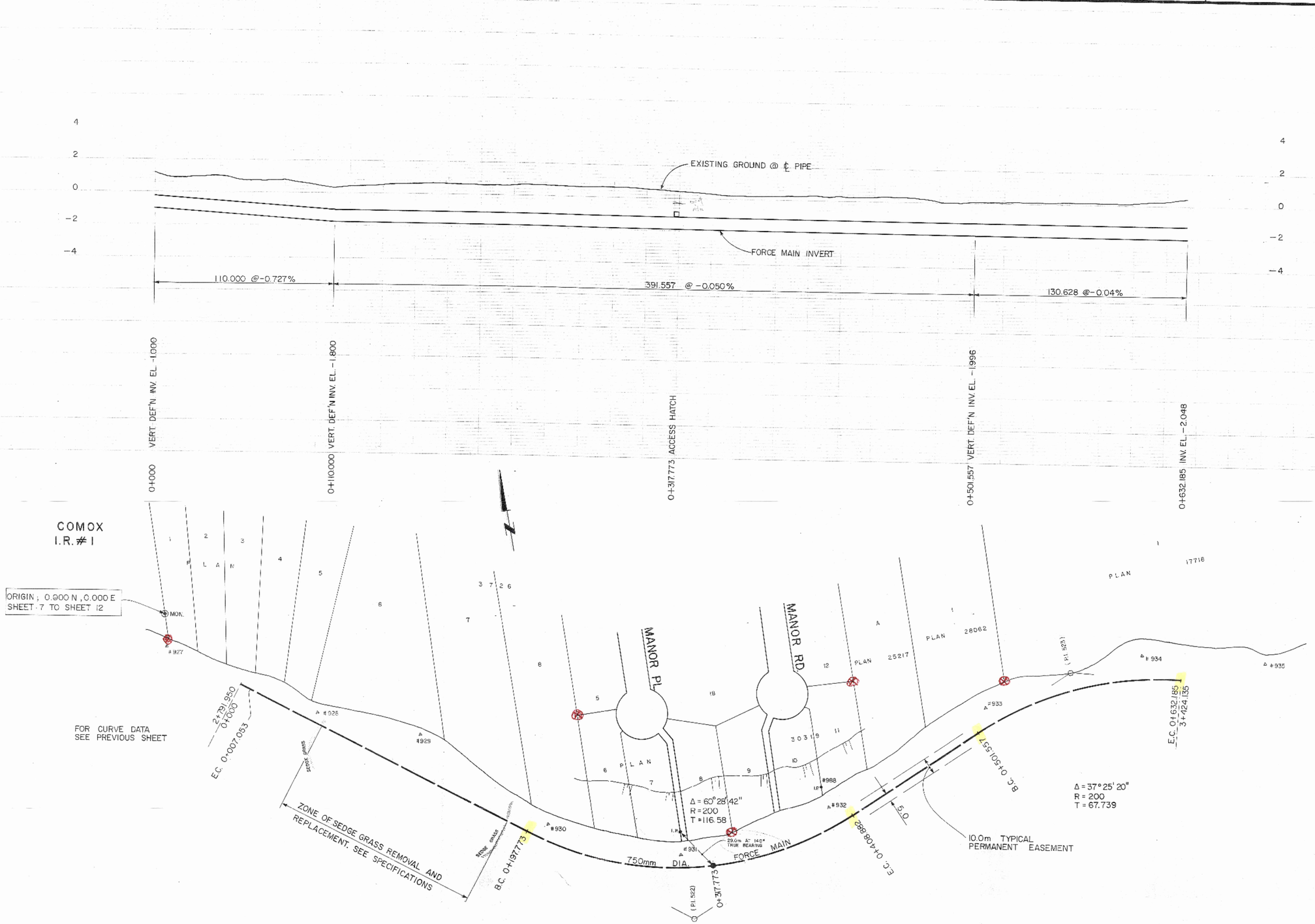
REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM

SEWAGE FORCE MAIN COURTENAY TO GOOSE SPIT CONTRACT S5

FORCE MAIN PLAN & PROFILE INDIAN RESERVE

DRAWING NUMBER	REV.	SHEET
S5-21-114	3	



ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
2	JAN. 83	[illegible]	[illegible]	AS CONSTRUCTED
1	JUNE '82	H.B.	[illegible]	CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	[illegible]
DESIGNED	W.J.H.
CHECKED	[illegible]
APPROVED	R.W. Sharp
APPROVED	
DATE	APRIL, 1982

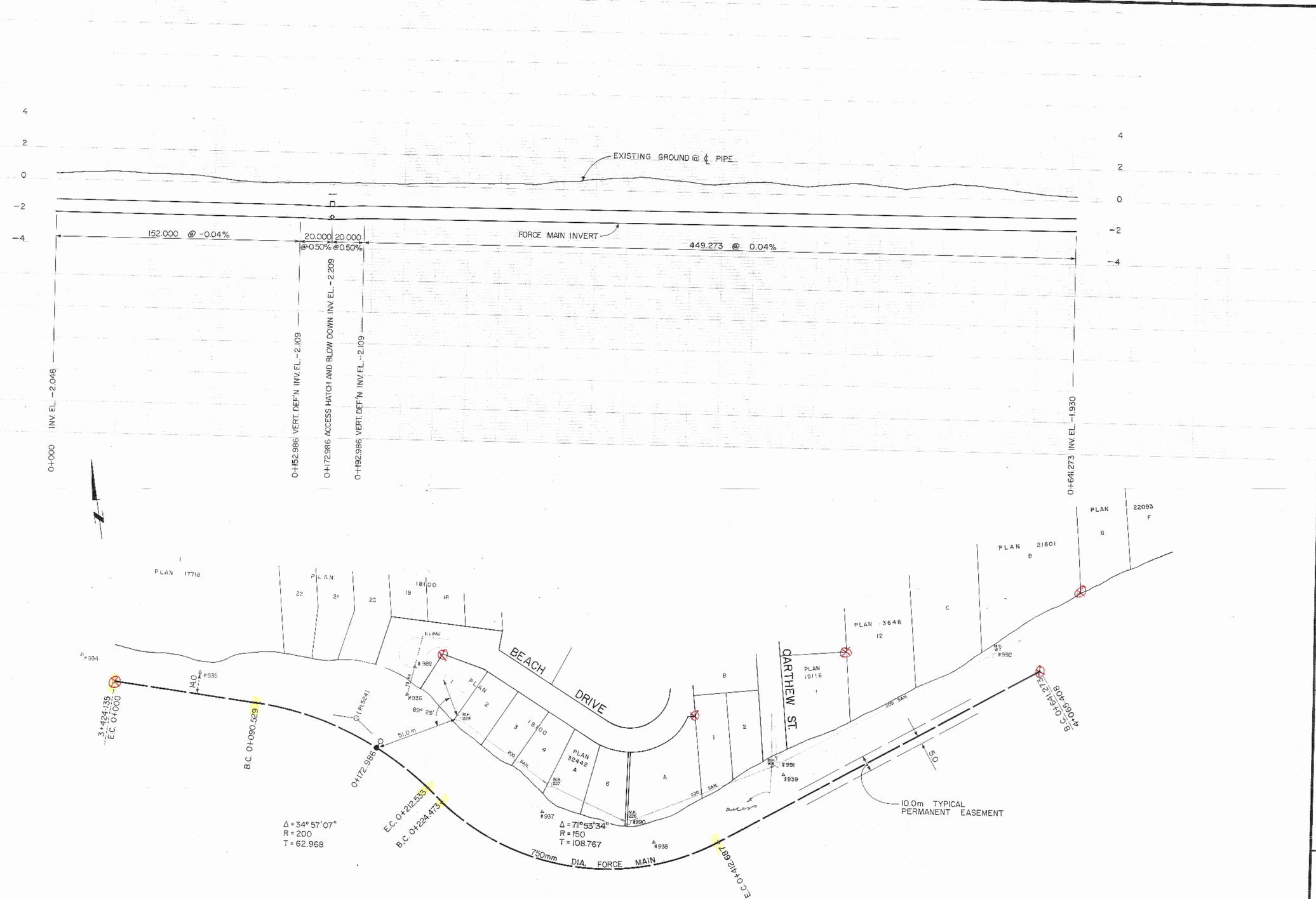
PROFESSIONAL ENGINEER OF BRITISH COLUMBIA R. W. SHARP REGISTERED ENGINEER

REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM

SEWAGE FORCE MAIN COURTENAY TO GOOSE SPIT CONTRACT S5

FORCE MAIN PLAN & PROFILE FORESHORE



ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡METRIC≡

NO	DATE	BY	ENG.	SUBJECT
2	JAN. '83			AS CONSTRUCTED
1	JUNE '82	H.B.		CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	AMB
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

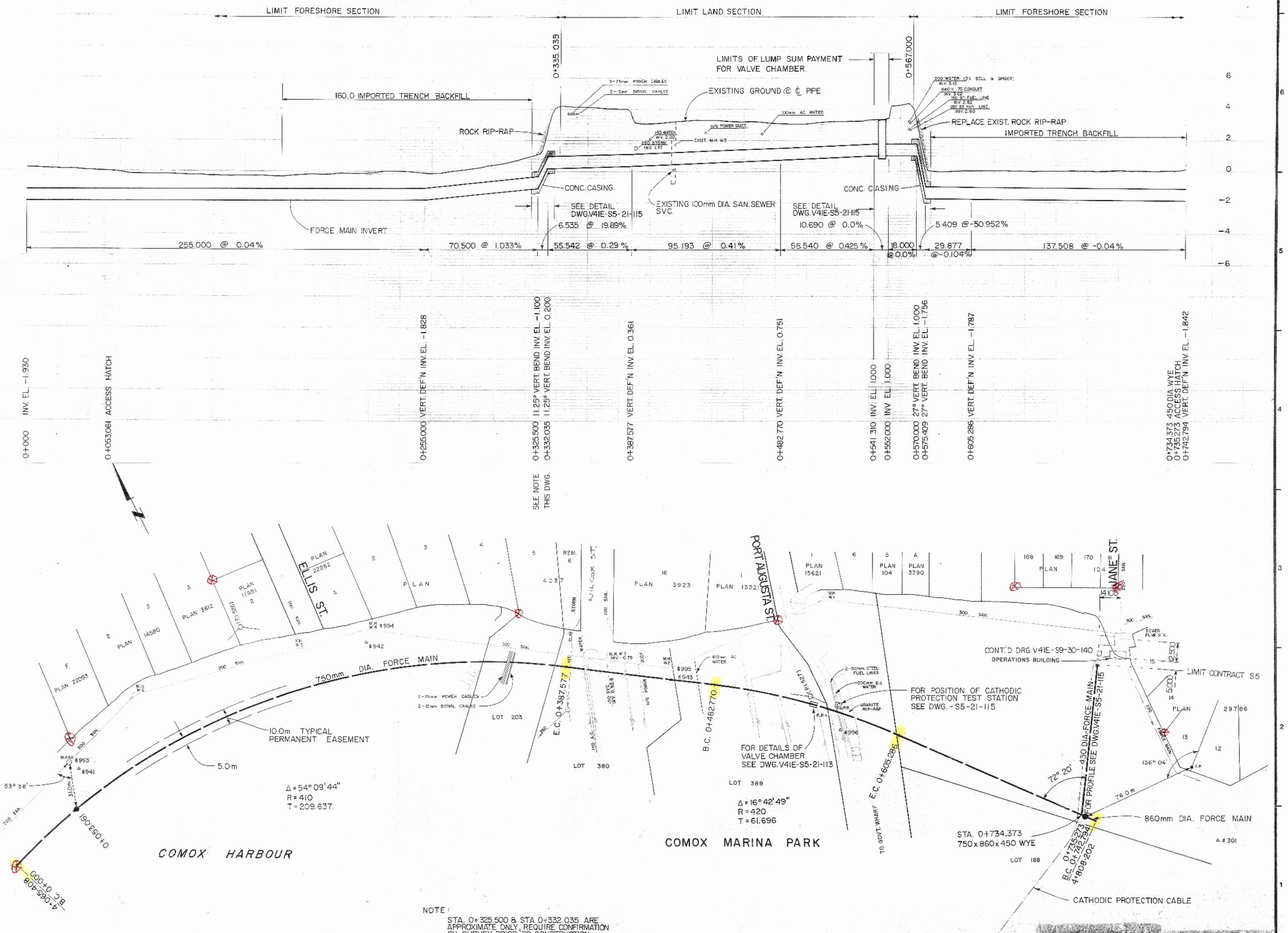
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R.W. SHARP

REGIONAL DISTRICT OF COMOX-STRATHCONA

REGIONAL SEWERAGE SYSTEM

SEWAGE FORCE MAIN COURTENAY TO GOOSE SPIT CONTRACT S5

FORCE MAIN PLAN & PROFILE FORESHORE



ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
2	JAN. '83			AS CONSTRUCTED
1	JUNE '82	H.B.		CONTROL ADDED

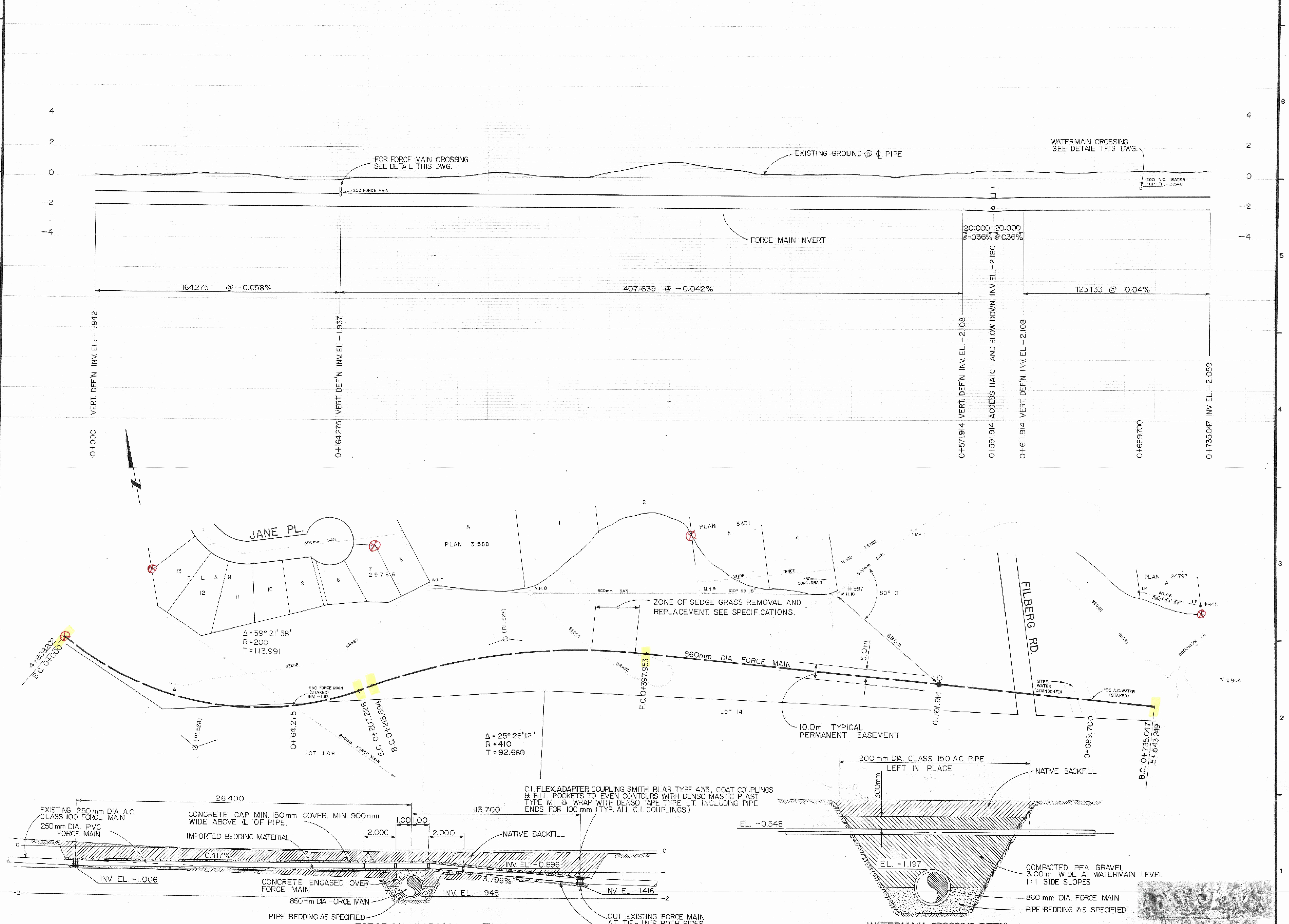
REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

FORCE MAIN PLAN & PROFILE FORESHORE & MARINA.



ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡METRIC≡

NO	DATE	BY	ENG.	SUBJECT
2	JAN. 83			AS CONSTRUCTED
1	JUNE '82	H.B.		CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

R. W. SHARP

REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

FORCE MAIN PLAN & PROFILE FORESHORE

DRAWING NUMBER	REV	SHEET

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

=METRIC=

NO	DATE	BY	ENG.	SUBJECT
2	JAN '83	MM		AS CONSTRUCTED
1	JUNE '82	HB		CONTROL ADDED

REVISIONS

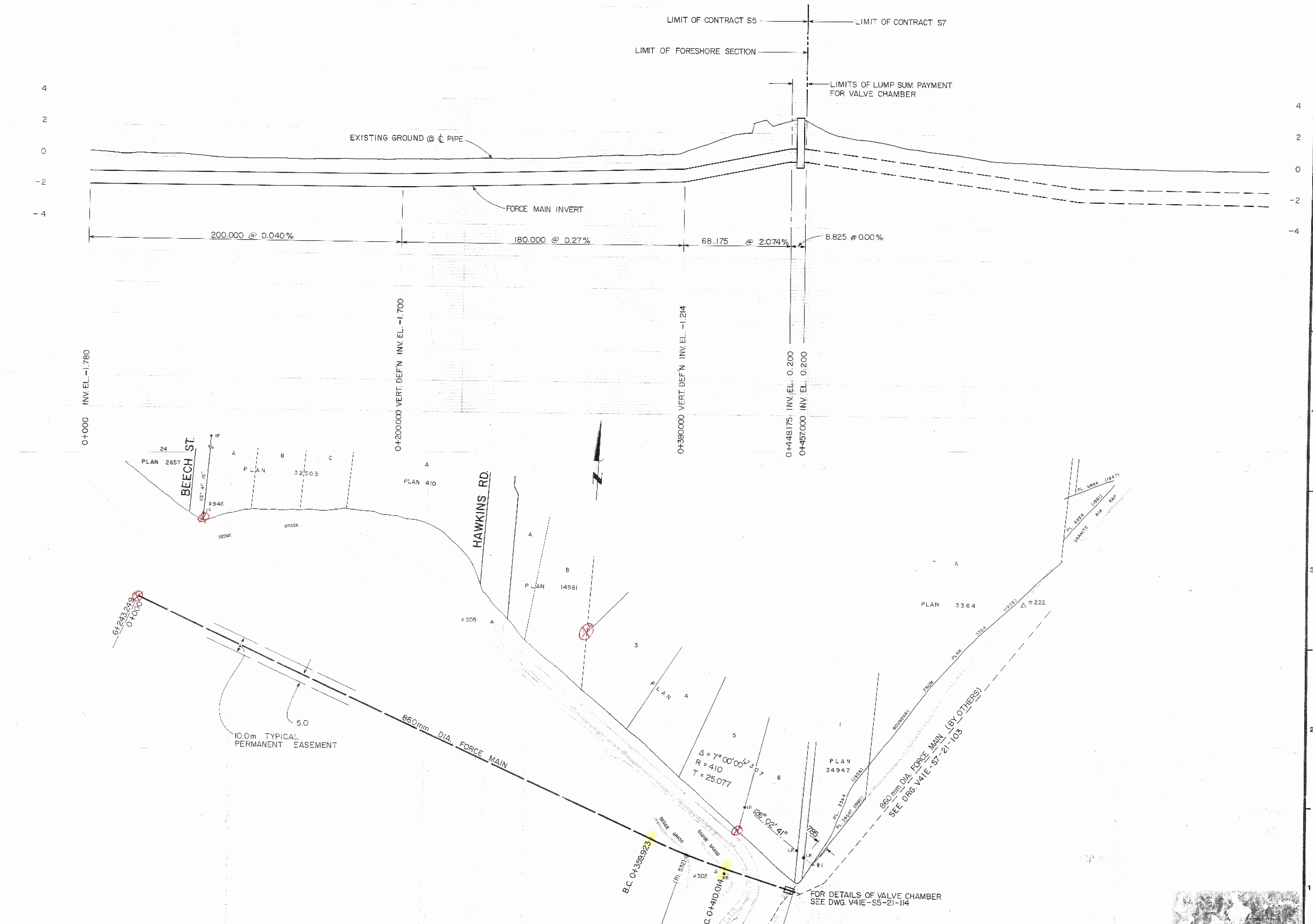
JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	HB
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM

SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

FORCE MAIN PLAN & PROFILE FORESHORE



ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

NO	DATE	BY	ENG.	SUBJECT
2	JAN. '83			AS CONSTRUCTED
1	JUNE '82	H.B.		CONTROL ADDED

REVISIONS

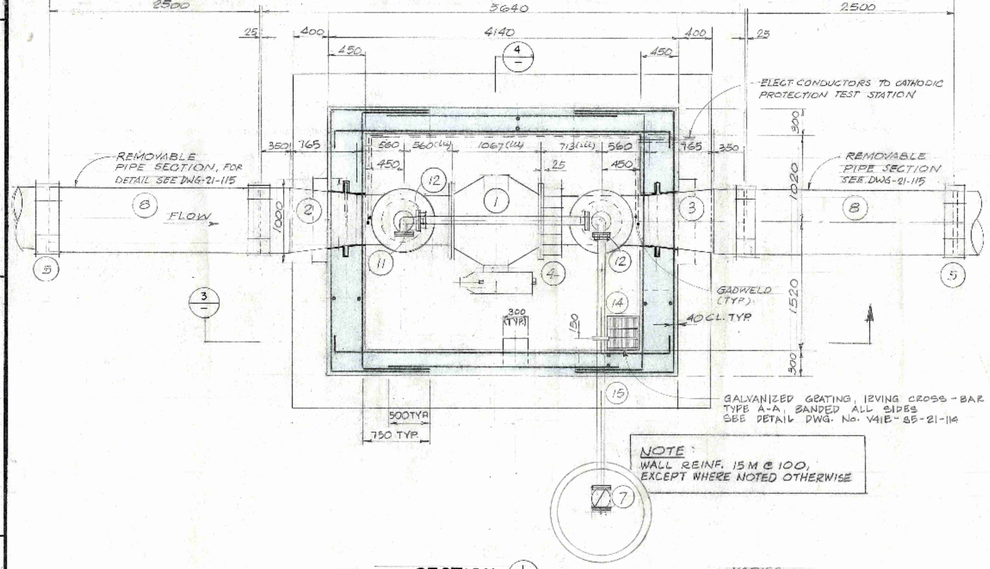
JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

PROFESSIONAL ENGINEER R. W. SHARP PROVINCE OF BRITISH COLUMBIA

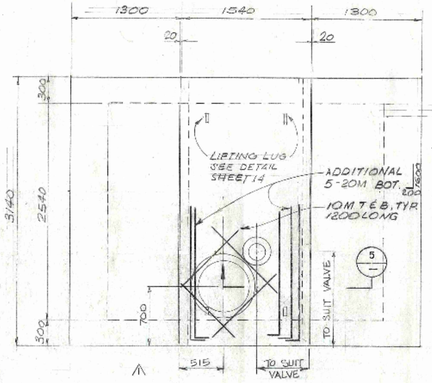
REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

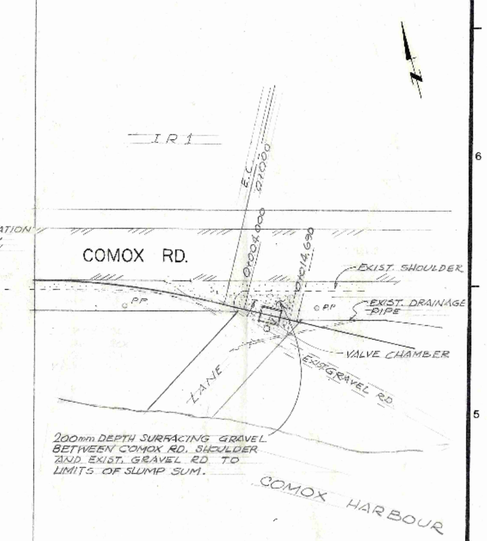
FORCE MAIN PLAN & PROFILE FORESHORE & HAWKINS RD.



PLAN VIEW AT (2)
1:30

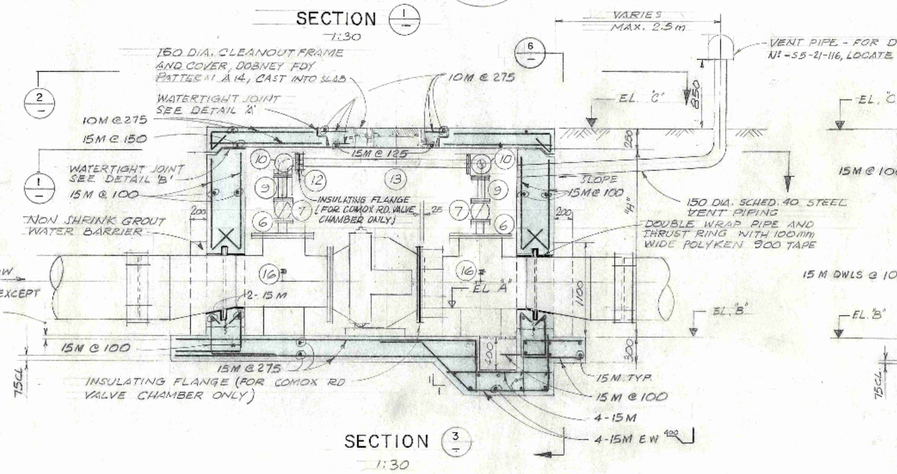


NOTE.
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

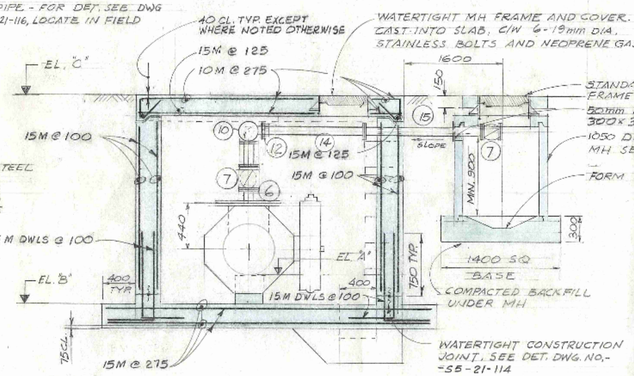


LOCATION PLAN FOR VALVE CHAMBER AT COMOX RD.
1:50

SECTION (1)
1:30

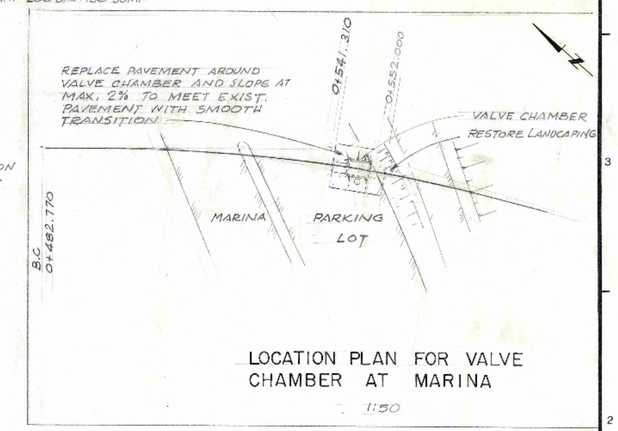


SECTION (3)
1:30



SECTION (4)
1:30

NOTE: ALL LOCATIONS OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED BY USE OF PIPE LOCATOR AND MANUAL DIGGING. ALL OR ANY EXISTING STRUCTURES NOT NECESSARILY SHOWN.
ELEVATIONS ARE TO GEODETIC DATUM.



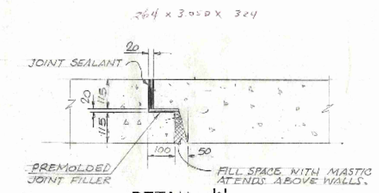
LOCATION PLAN FOR VALVE CHAMBER AT MARINA
1:50

VALVE CHAMBERS AT COMOX ROAD AND MARINA

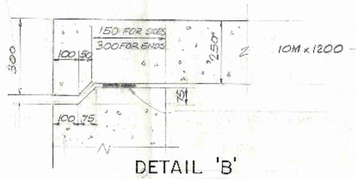
ELEVATIONS AND DIMENSIONS	EL. "A"	EL. "B"	EL. "C"	"H"
VALVE CHAMBER AT COMOX RD.	2.800m	2.450m	4.600m	1.900m
VALVE CHAMBER AT MARINA	1.150m	0.800m	3.300m	2.250m

ITEM	SIZE (NOMINAL)	NO.	MATERIAL SCHEDULE (ALL STEEL PIPE FITTINGS SHALL BE TO AWWA C 208 SPECIFICATIONS)
1	600	1	BALL OR PLUG VALVE, FL x FL(ii) GEAR ACTUATOR WITH SQ. OPERATING NUT (ii)
2		1	750(i) x 600 x 500 ECCENTRIC REDUCER TEE, PE x FL x FL, C/W 25 x 100 THRUST RING (i,ii)
3		1	750(i) x 600 x 500 ECCENTRIC REDUCER TEE, PE x PE x FL, C/W 25 x 100 THRUST RING (i,ii)
4	600	1	FLANGE ADAPTER COUPLING
5	750(i)	4	FLEXIBLE STEEL COUPLING
6		2	FLANGED REDUCER 500 x 100, 200 LG
7	100	3	BALL OR PLUG VALVE, FL x FL ; LEVER OPERATOR IN VALVE CHAMBER, 50 mm SQ. OPERATING NUT IN MH.
8	750(i)	2	STEEL PIPE PE x PE, 2500 LG. WITH HARNESS LUGS
9	100	2	SCHEDULE 40 STEEL PIPE FL x FL, 500 LG. NOT REQUIRED FOR COMOX RD. VALVE CHAMBER.
10	100	2	90° C.I. BEND WITH 100 DIA. SIDE OUTLET, FL x FL x FL
11	100	1	BLIND FLANGE
12	100	2	FLANGE ADAPTER WITH 2 ANCHOR STUDS
13	100	2	SCHEDULE 40 STEEL PIPE, PE x FL, DRILLED TO SUIT ANCHOR STUDS
14	100	1	SCHEDULE 40 STEEL PIPE, PE x FL, DRILLED TO SUIT ANCHOR STUDS
15	100	1	SCHEDULE 40 STEEL PIPE WITH 12 x 50 THRUST RING, FL x FL, 1700 LG, COAL TAR ENAMEL COATED
16		2	GAUGE CONNECTION: 19mm THREDOLET, 19mm GALV. STREET ELBOW & 19 x 6mm BRASS BUSHING, 6mm BRASS UNION COCK.

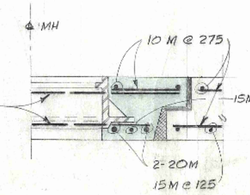
(i) OR TO SUIT FORCE MAIN JOINT O.D.
(ii) VALVE OPERATOR POSITION TO SUIT CHAMBER LAYOUT, PLUG TO OPEN UPWARD FOR HORIZONTAL VALVE INSTALLATION.
(iii) DIMENSION SHOWN AT SECTION 1 - MAY CHANGE TO SUIT VALVE.



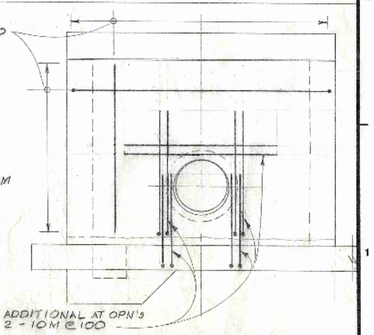
DETAIL 'A'
WATERTIGHT JOINT
1:10



DETAIL 'B'
WATERTIGHT JOINT
1:10



SECTION (5)
1:10



ELEVATION (6)

ASSOCIATED ENGINEERING SERVICES LTD.
AESL

DRAWING REFERENCE

≡ METRIC ≡

NO	DATE	BY	ENG.	SUBJECT
2	JAN. '83	KM		AS CONSTRUCTED
1	OCT. '82	KM		VANCOUVER LOCATION REVISED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	V.W.
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

STAMPS

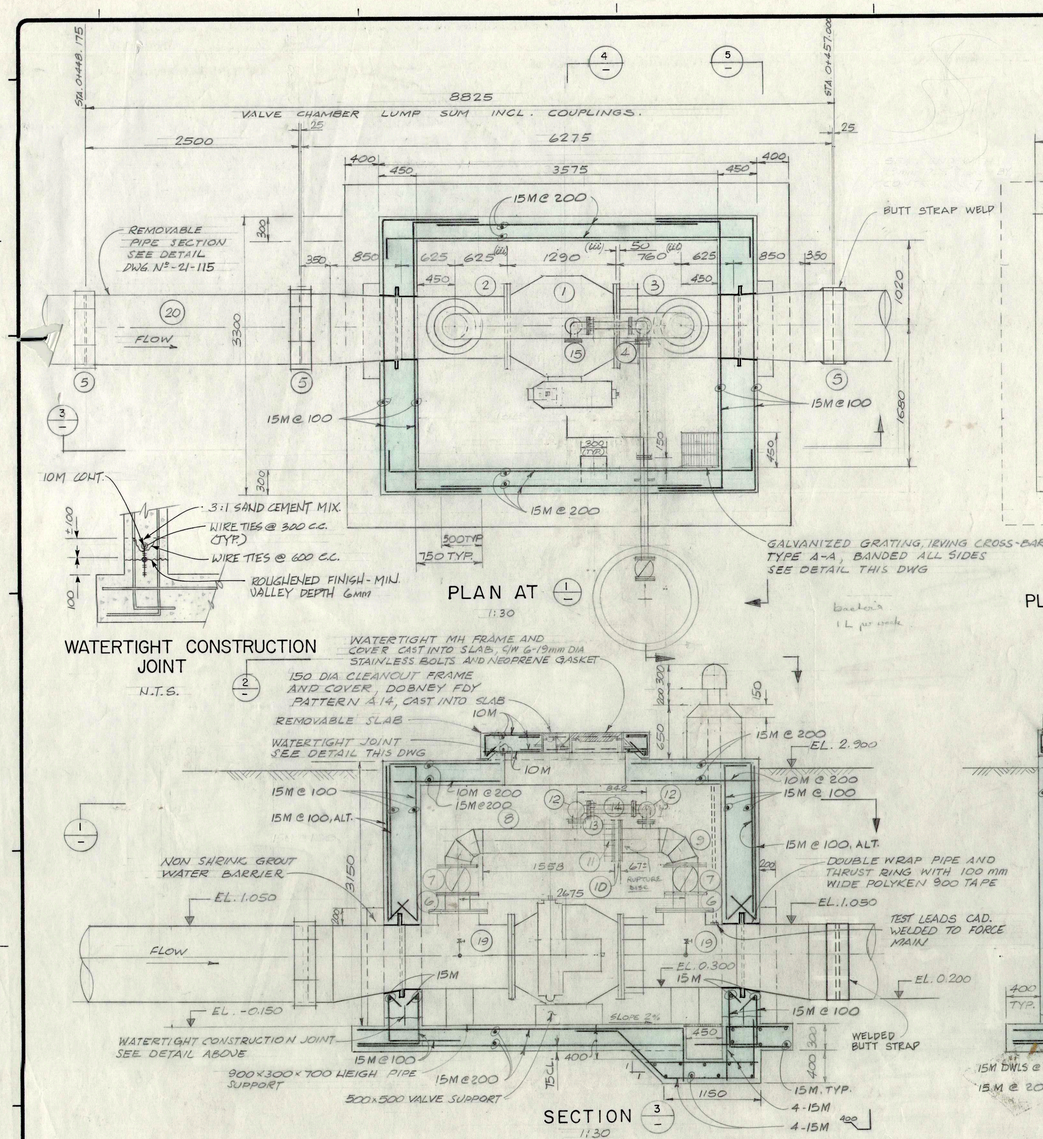
CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

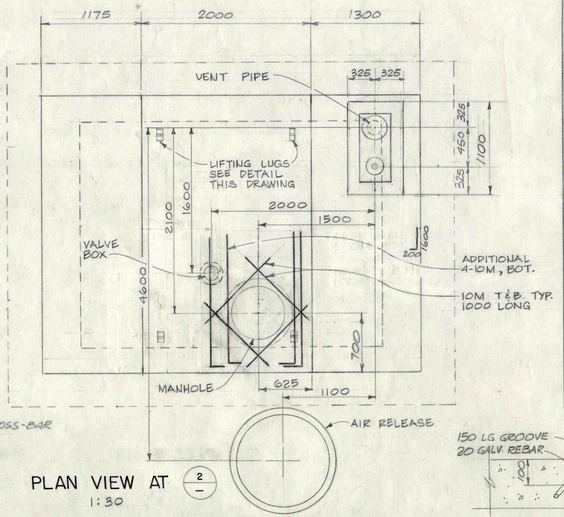
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

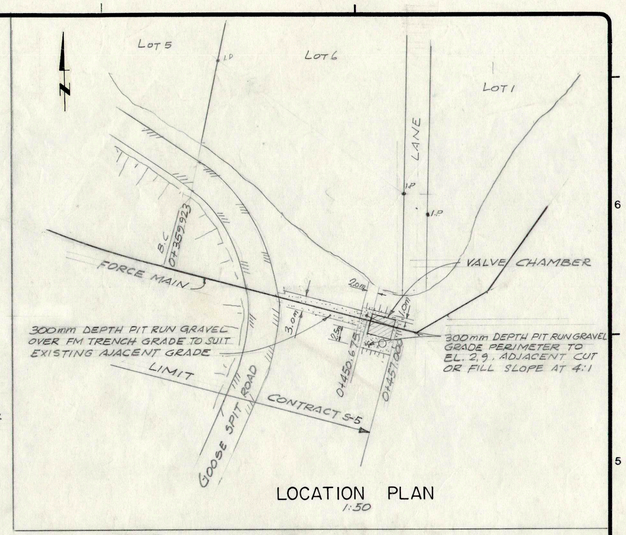
PROJECT

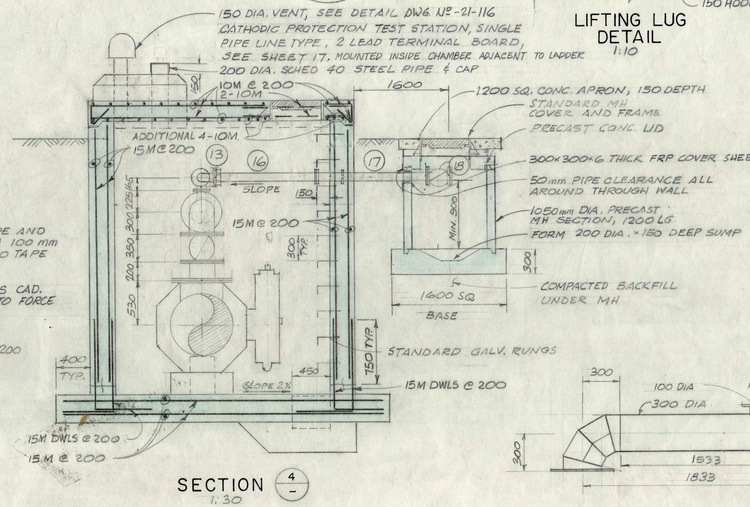
SUBJECT
VALVE CHAMBERS AT COMOX RD. AND COMOX MARINA

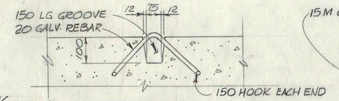
DRAWING NUMBER	REV	SHEET
	2	13

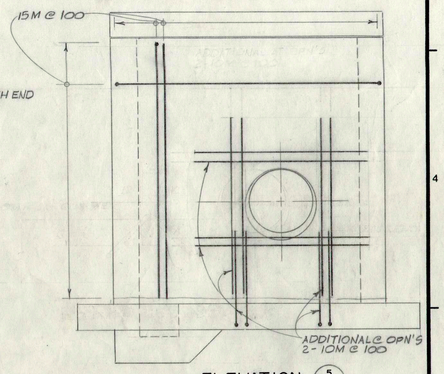


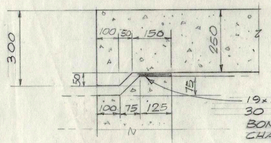


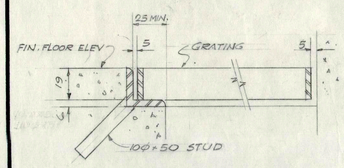








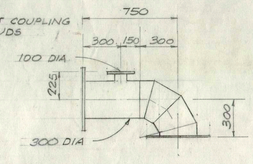




ITEM	SIZE (NOMINAL)	NO	MATERIAL SCHEDULE - ALL STEEL FITTINGS SHALL BE TO AWWA C 208 SPECIFICATIONS
1	750	1	BALL OR PLUG VALVE, FL×FL, GEAR ACTUATOR WITH SQUARE OPERATING NUT (ii)
2		1	850(i) × 750 × 500 ECCENTRIC REDUCER TEE, PE×FL×FL C/W 25×100 THRUST RING (iii)
3		1	850(ii) × 750 × 500 ECCENTRIC REDUCER TEE, PE×PE×FL C/W 25×100 THRUST RING (iii)
4	750	1	FLANGE ADAPTER COUPLING
5	850(ii)	2	FLEXIBLE STEEL COUPLING
6		2	FLANGED REDUCER 500×300, 200 LG
7	300	2	CAST IRON BALL OR PLUG VALVE, FL×FL, GEAR ACTUATOR AND HANDWHEEL
8	300	1	90° BEND AND SPECIAL FITTING, SEE DETAIL THIS DRAWING
9	300	1	90° BEND " " " " " " "
10	300	1	RUPTURE DISK

ITEM	SIZE (NOMINAL)	No.	MATERIAL SCHEDULE - ALL STEEL FITTINGS SHALL BE TO AWWA C 208 SPECIFICATIONS.
11	300	1	FLANGE ADAPTER COUPLING, SMITH BLAIR TYPE 913 WITH 4 ANCHOR STUDS, OR EQUAL
12	100	2	90° CAST IRON BEND, WITH 100 DIA SIDE OUTLET, FL×FL×FL
13	100	2	FLANGE ADAPTER, WITH 2 ANCHOR STUDS
14	100	1	SCH. 40 STEEL PIPE 487 LG, PE×FL, DRILLED TO SUIT ANCHOR STUDS
15	100	1	BLIND FLANGE
16	100	1	SCHED. 40 STEEL PIPE, PE×FL. DRILLED TO SUIT ANCHOR STUDS
17	100	1	SCHED. 40 STEEL PIPE WITH 12×50 THRUST RING, FL×FL, 1700 LG, COAL TAR ENAMEL COATED
18	100	1	BALL OR PLUG VALVE, FL×FL, 50mm SQ. OPERATING NUT
19		2	GAUGE CONNECTION: 19mm THREADOLET, 19mm GALV. STREET ELBOW 19×6mm BRASS BUSHING, 6mm BRASS UNION COCK
20	850(ii)	1	STEEL PIPE P.E.×P.E. 2500 LG. WITH HARNESS LUGS

(i) OR TO SUIT FORCE MAIN JOINT O.D.
(ii) VALVE OPERATOR POSITION TO SUIT CHAMBER LAYOUT, PLUG TO OPEN TO UPWARD FOR HORIZONTAL VALVE INSTALLATION.
(iii) DIMENSION SHOWN AT SECTION 1 MAY CHANGE TO SUIT VALVE



NOTE: ALL LOCATIONS OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED BY USE OF PIPE LOCATOR AND MANUAL DIGGING. ALL OR ANY EXISTING STRUCTURES NOT NECESSARILY SHOWN.
ELEVATIONS ARE TO GEODETIC DATUM.

ASSOCIATED ENGINEERING SERVICES LTD.
AESL

DRAWING REFERENCE

≡METRIC≡

NO	DATE	BY	ENG.	SUBJECT
1	JAN. '83	WH		AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	V.W.
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

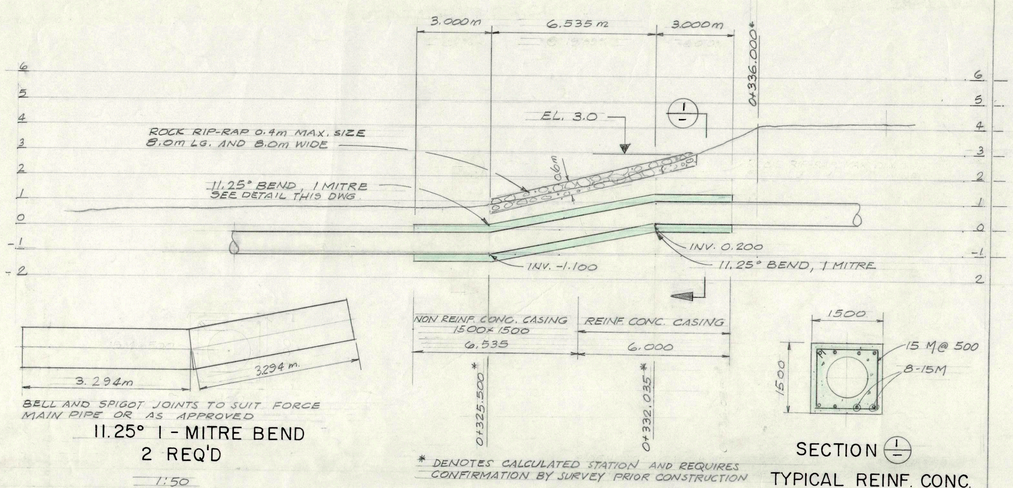
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R.W. SHARP

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

PROJECT
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

SUBJECT
VALVE CHAMBER AT GOOSE SPIT

DRAWING NUMBER	REV	SHEET
V41E-S5-21-114	1	14/18



11.25° 1 - MITRE BEND
2 REQ'D

1:50

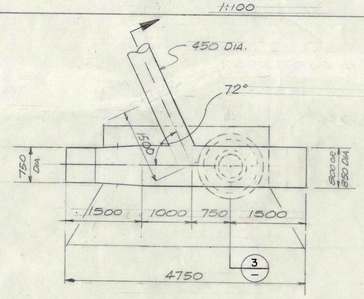
DETAIL OF MARINA EMBANKMENT SECTION
STA. 0+320 TO 0+336

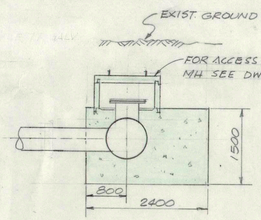
1:100

SECTION (1/-)

TYPICAL REINF. CONC. CASING

N.T.S.





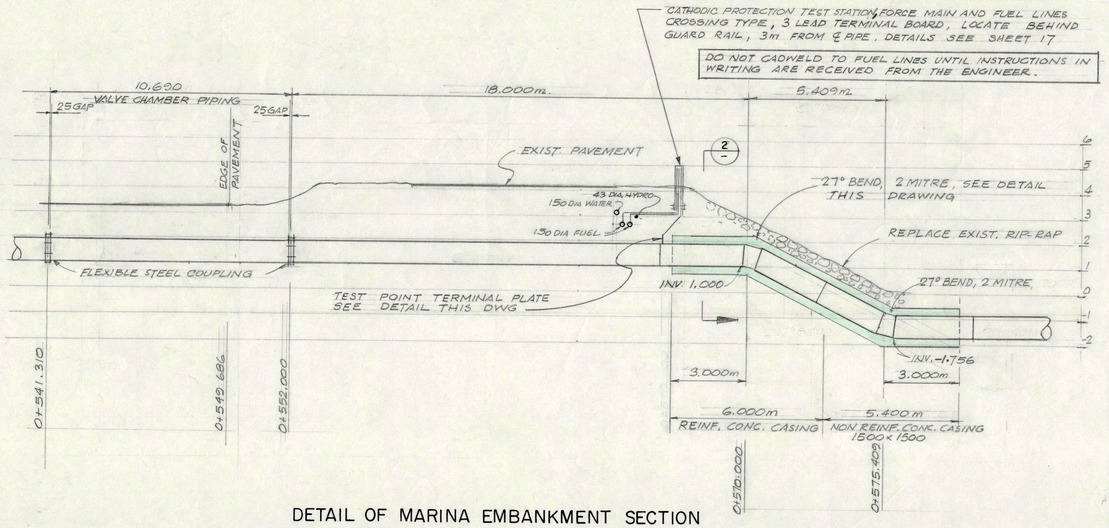
SECTION (3/-)

1:50

750 DIA AND 800 OR 850 DIA. ENDS TO BE BE BELL AND SPIGOT JOINTS TO SUIT FORCE MAIN PIPE OR AS APPROVED.

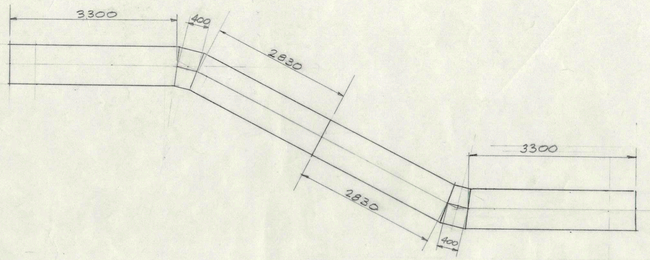
COMOX PUMP STATION FORCE MAIN CONNECTION WYE AND REDUCER FITTING

1:50



DETAIL OF MARINA EMBANKMENT SECTION
STA. 0+542 TO STA. 0+580

1:100

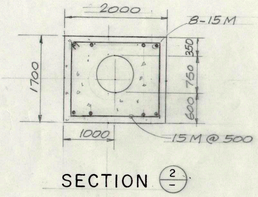


27° 2-MITRE BENDS

1:50

R=1700

BELL AND SPIGOT JOINTS TO SUIT FORCE MAIN PIPE OR AS APPROVED



SECTION (2/-)

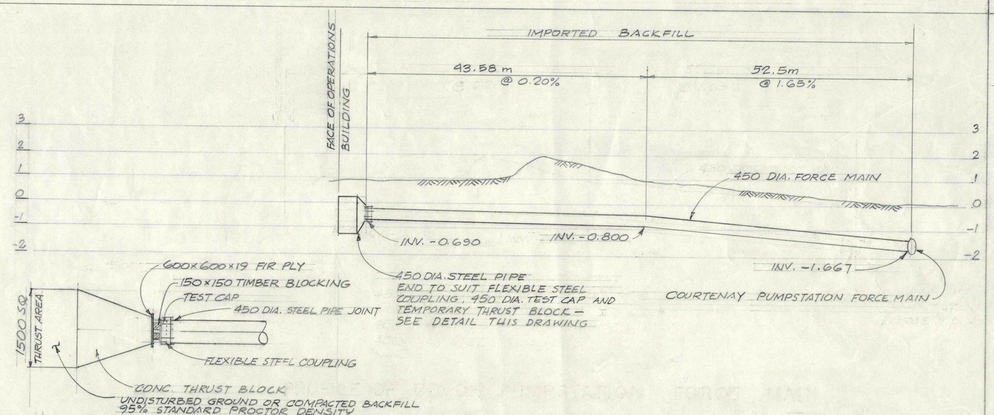
TYPICAL REINF. CONC. CASING

1:50

NOTE
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

NOTE: ALL LOCATIONS OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED BY USE OF PIPE LOCATOR AND MANUAL DIGGING. ALL OR ANY EXISTING STRUCTURES NOT NECESSARILY SHOWN.

ELEVATIONS ARE TO GEODETIC DATUM.

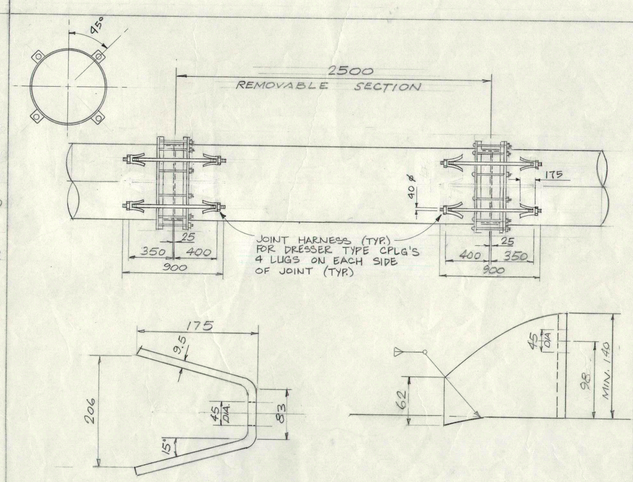


TEMPORARY THRUST BLOCK DETAIL

1:50

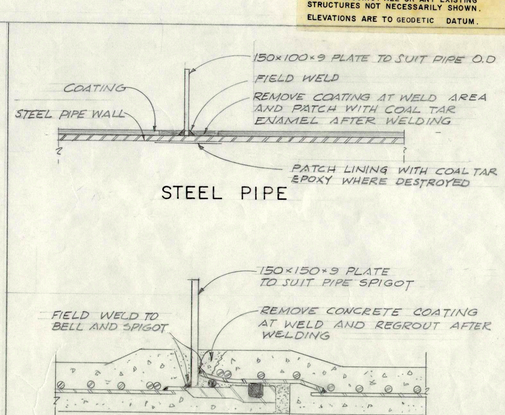
PROFILE OF COMOX PUMP STATION

HOR. 1:500
VERT. 1:100



REMOVABLE SECTION DETAIL

N.T.S.



STEEL PIPE

CONCRETE CYLINDER PIPE
TEST POINT TERMINAL PLATE DETAIL

N.T.S.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡METRIC≡

NO	DATE	BY	ENG.	SUBJECT
1	FEB '83	JKM		AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	V.W.
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

STAMPS

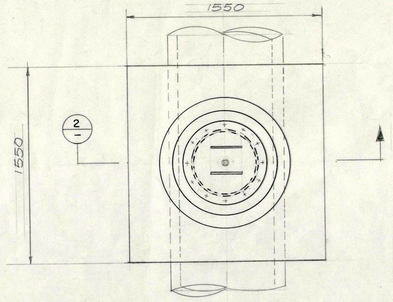
R.W. SHARP REGISTERED PROFESSIONAL ENGINEER

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

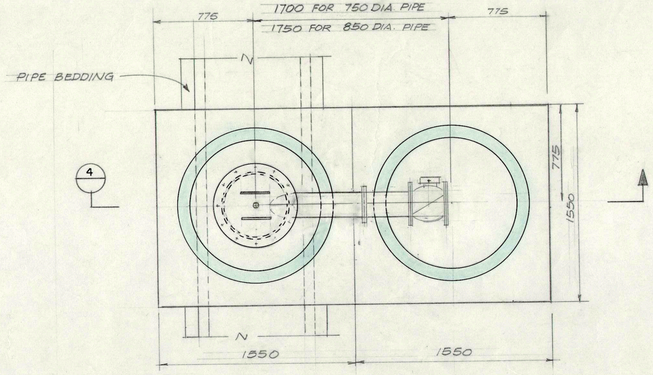
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

SUBJECT
PIPING DETAILS & COMOX PUMP STATION FORCE MAIN PROFILE

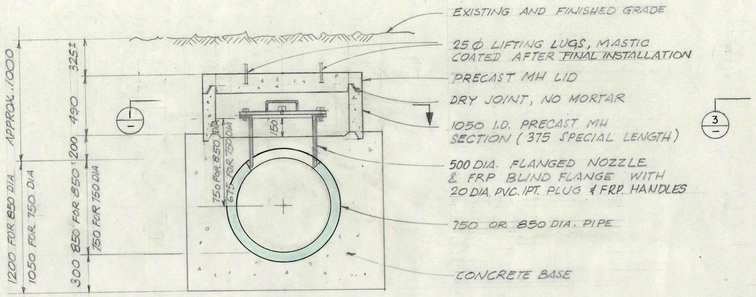
DRAWING NUMBER	REV	SHEET
V41E-S5-21-115	1	15/18



PLAN AT (1)

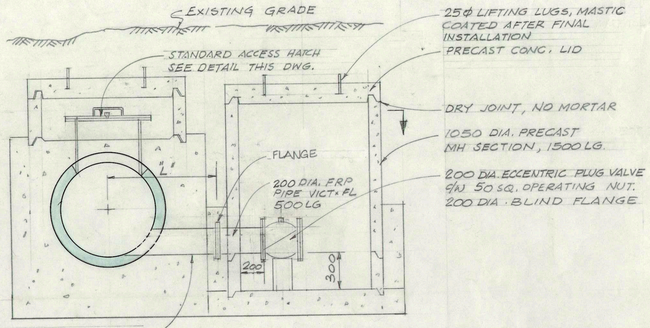


PLAN AT (3)



SECTION (2)
ACCESS HATCH DETAIL

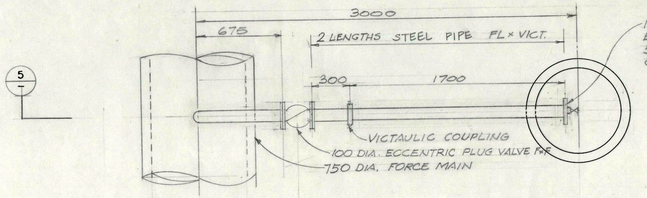
1:20



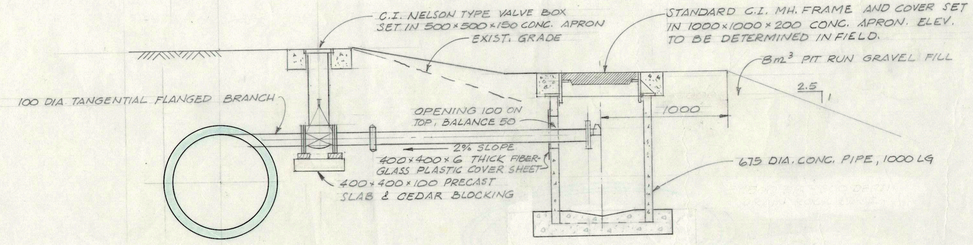
SECTION (4)
BLOW DOWN DETAIL

1:20

DIMENSIONS FOR "L": 750 DIA PIPE 925
850 " " 975



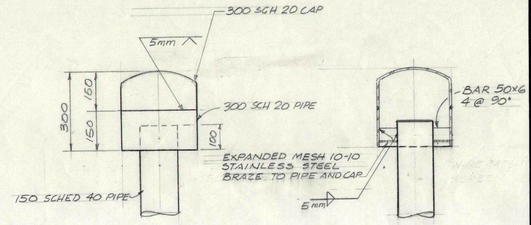
PLAN



SECTION (5)
AIR VALVE ASSEMBLY DETAIL
(COMOX ROAD)

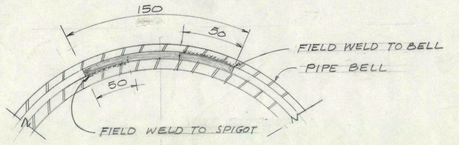
1:20

NOTE.
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

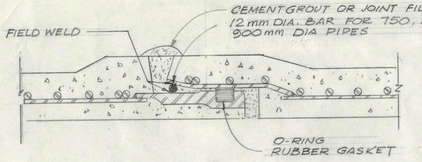


VALVE CHAMBER VENT DETAIL

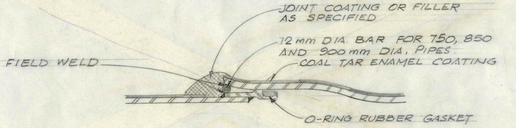
N.T.S.



TYPICAL SECTION



CONCRETE CYLINDER PIPE



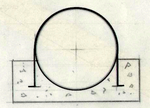
STEEL PIPE

FOR COMBINED RESTRAINED THRUST AND CONDUCTIVITY JOINTS SHOP DRAWINGS SHALL SUBMITTED TO THE ENGINEER FOR APPROVAL.

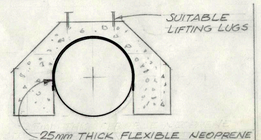
CONDUCTIVITY CONNECTION DETAIL

N.T.S.

PIPE ANCHORING REQUIREMENTS AND ALTERNATIVES FOR STEEL PIPE IN FORESHORE SECTION



CONTINUOUS OR INTERMITTENT CONCRETE BEDDING WITH APPROVED TIE DOWN BARS WITH MAX. SPACING OF 12.2 m SEE NOTE 2



PRECAST CONC. ANCHOR BLOCK WITH CENTRE OF GRAVITY BELOW CENTER OF PIPE MAX. SPACING OF 12.2 m. SEE NOTE 2

CONTINUOUS OR INTERMITTENT CONC. COATING WITH MIN. THICKNESS 70mm FOR ALL PIPE SIZES. CENTER TO CENTER INTERVALS SHALL NOT EXCEED 12.2 m

CONCRETE BEDDING, PRECAST CONC. ANCHOR BLOCK OR CONCRETE COATING WEIGHT

LOCATION	PIPE DIA.	WEIGHT TO BE ADDED Kg/m (WEIGHT IN AIR)
INNER HARBOUR (WEST OF GOOSE SPIT ROAD)	450 mm	0
	750 mm	85
	850 mm	249
OUTER HARBOUR (EAST OF GOOSE SPIT ROAD)	850 mm	64
	900 mm	153

NOTES:

1. AT HORIZ. BENDS 22½° AND OVER, WYE FITTINGS, REMOVABLE PIPE SECTIONS AND ACCESS HATCHES, ADDITIONAL ANCHORING EQUIVALENT TO ONE UNIT OF THE SELECTED ALTERNATIVE METHOD SHALL BE INSTALLED.
2. SHOP DRAWINGS SHOWING DIMENSIONS AND REINFORCING SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡METRIC≡

NO	DATE	BY	ENG.	SUBJECT
1	JUNE 82	JAM		AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	V.W
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

STAMPS

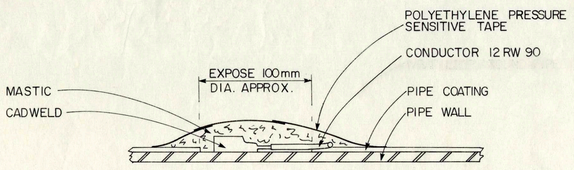
PROFESSIONAL ENGINEER R.W. SHARP BRITISH COLUMBIA

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

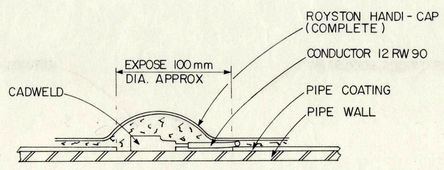
SPECIAL STRUCTURES & FITTINGS

DRAWING NUMBER	REV	SHEET
V41E-S5-21-116	1	16/18



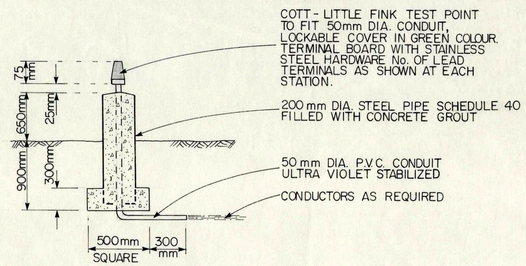
CADWELD COVERED BY MASTIC & TAPE

SCALE : N.T.S.



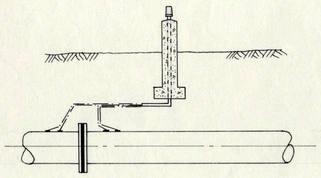
CADWELD COVERED BY HANDI-CAP

SCALE : N.T.S.

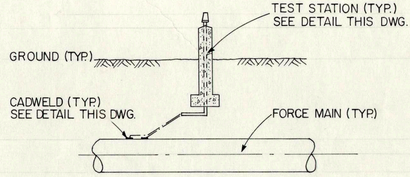


TYPICAL TEST STATION DETAIL

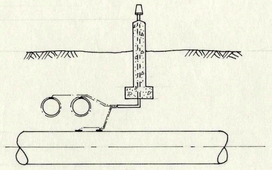
SCALE : N.T.S.



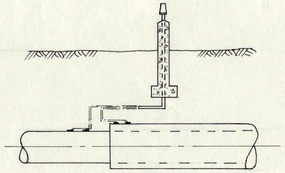
FORCE MAIN & INSULATING FLANGE



SINGLE PIPELINE TEST STATION (SINGLE LINE TWO LEAD TYPE)



FORCE MAIN & FUEL LINES CROSSING TEST STATION



FORCE MAIN & CASING TEST STATION

TYPICAL TEST STATION LAYOUTS

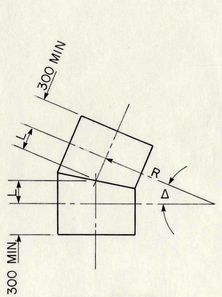
SCALE : N.T.S.

NOTE :

1. DOUBLE CONDUCTORS FOR EACH PIPE, EACH WITH ITS OWN WELD. CONDUCTORS TO BE COLOUR CODED :

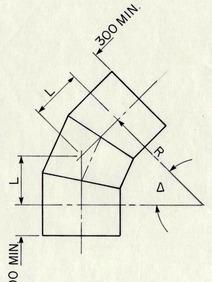
FORCE MAIN	BLACK
FUEL LINES	RED & GREEN
CASING PIPE	RED

2. CONDUCTORS TO BE No. 12 RW 90 STRANDED CABLE.
3. CONDUCTORS TO BE STRAPPED TO PIPE OUTSIDE OF CADWELD PATCH WITH No. 425 POLYBAND, FORM HORIZONTAL S, 600mm DIA. RADIUS EACH HALF AT PIPE AND AT BOTTOM OF TEST STATION.



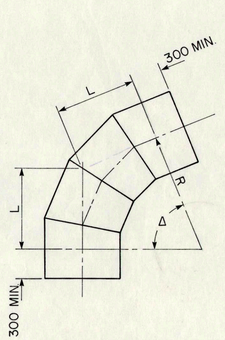
2 PIECE BEND

(0° TO 20°)



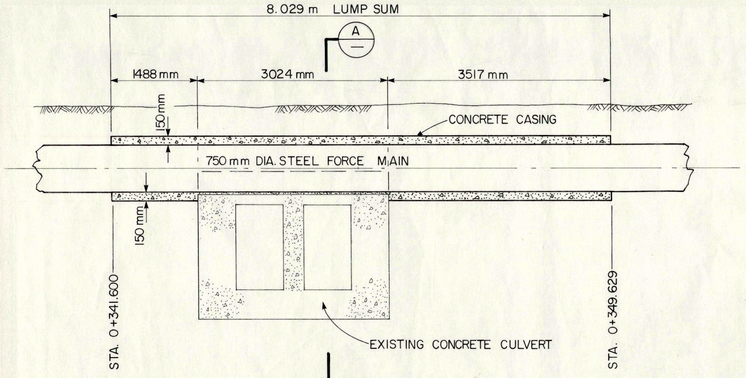
3 PIECE BEND

(20° TO 45°)



4 PIECE BEND

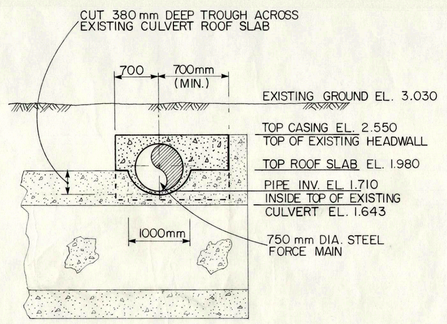
(45° TO 65°)



ELEVATION AT FLOOD GATES

(SEEN ON DWG. - S5-21-103)

SCALE = 1:40

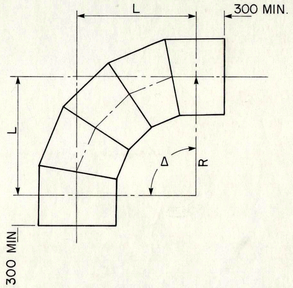


SECTION A

SCALE = 1:40

TABLE OF 'L' VALUES				
PIPE DIA.	2 PIECE	3 PIECE	4 PIECE	5 PIECE
750	264.5	621.3	955.6	1500.0
860	303.3	712.5	1095.8	1720.0
900	317.4	754.6	1146.7	1800.0

NOTE : FOR ALL BENDS $R = \frac{L}{\tan\frac{\Delta}{2}}$



5 PIECE BEND

(65° TO 90°)

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡ METRIC ≡

NO	DATE	BY	ENG.	SUBJECT
1	FEB '83			AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	PJT
DESIGNED	W.J.H.
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

STAMPS

R.W. SHARP PROFESSIONAL ENGINEER BRITISH COLUMBIA

CLIENT

REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM

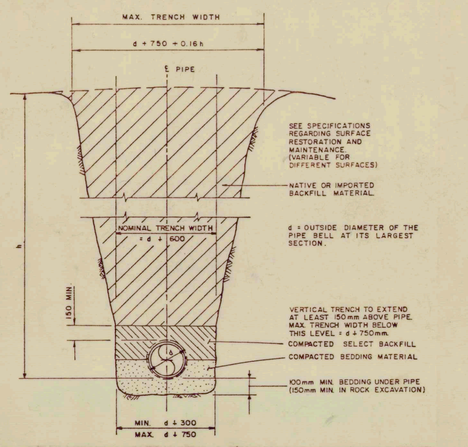
SEWAGE FORCE MAIN COURTENAY TO GOOSE SPIT

CONTRACT S5

SUBJECT

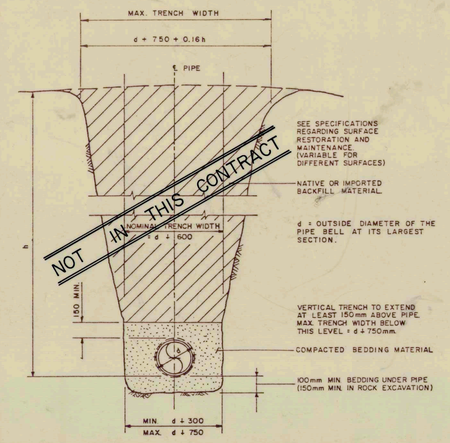
BENDS & CATHODIC TEST STATION DETAILS

DRAWING NUMBER	REV	SHEET
V41E-S5-21-117	1	17/18



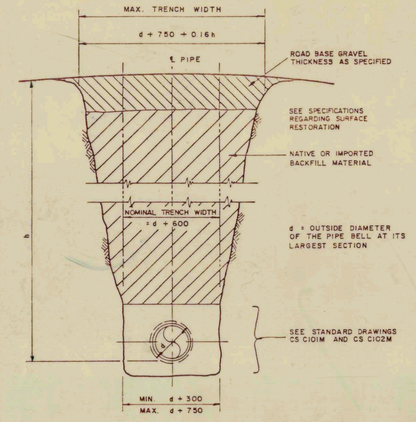
STANDARD SECTION

CS C101M



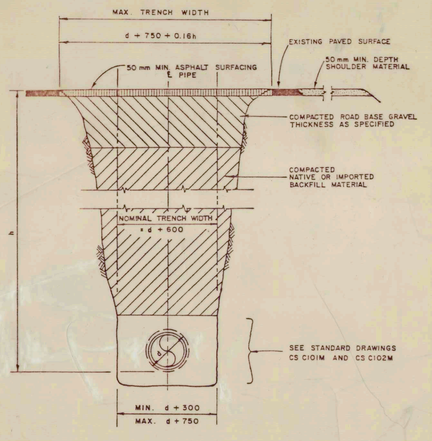
SECTION FOR PVC PIPE

CS C102M



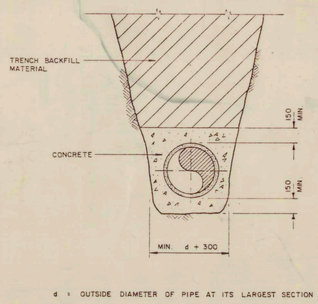
SECTION IN GRAVELLED SURFACE

CS C103M



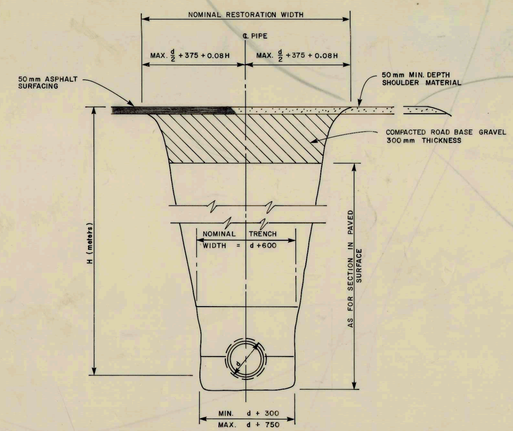
SECTION IN PAVED SURFACE

CS C104M



CONCRETE ENCASEMENT - NON REINFORCED

CS C106M



SECTION IN PARTIALLY PAVED SURFACE

CS C106M

NOTE.
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡ METRIC ≡

NO	DATE	BY	ENG.	SUBJECT
1	JAN. '83			AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	NOT TO SCALE
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM

SEWAGE FORCE MAIN
COURTENAY TO GOOSE SPIT
CONTRACT S5

TRENCH DETAILS

DRAWING NUMBER	REV	SHEET
V41E-S5-21-118	1	18/18

REGIONAL DISTRICT OF
COMOX - STRATHCONA

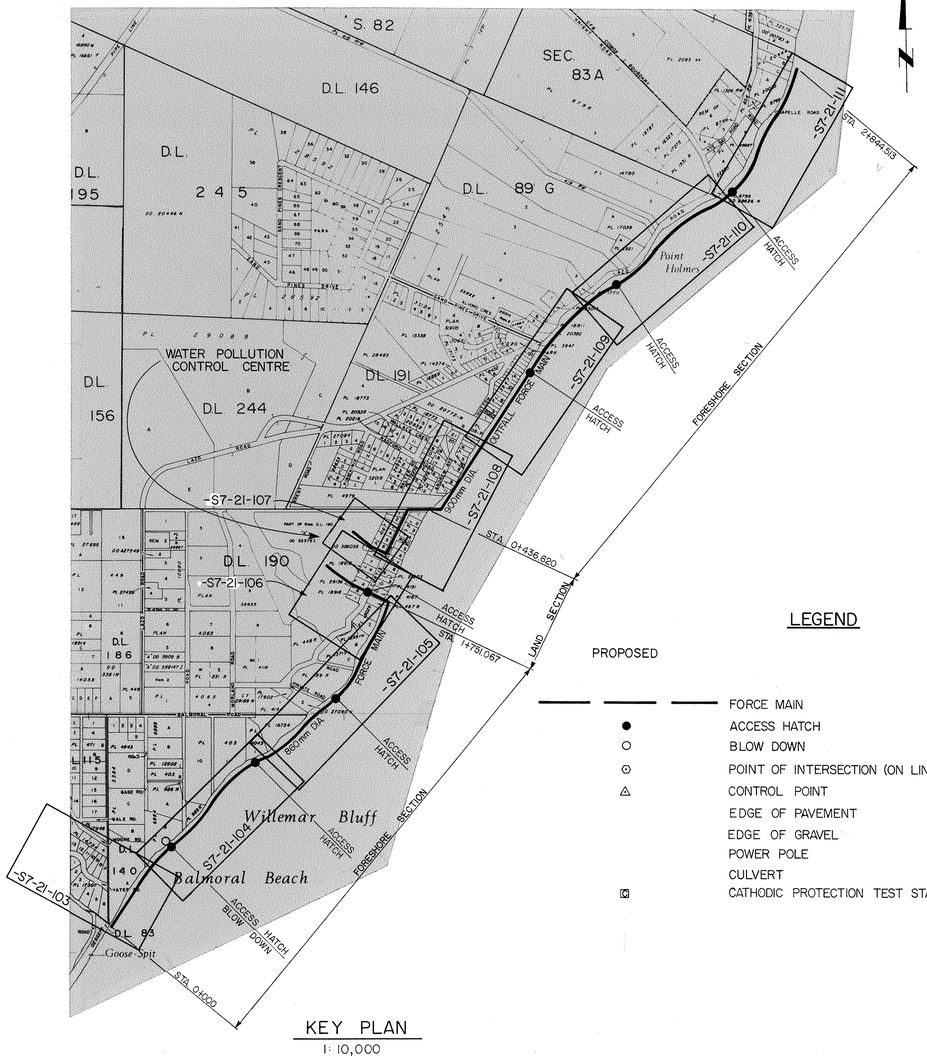
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO

CONTRACT S7

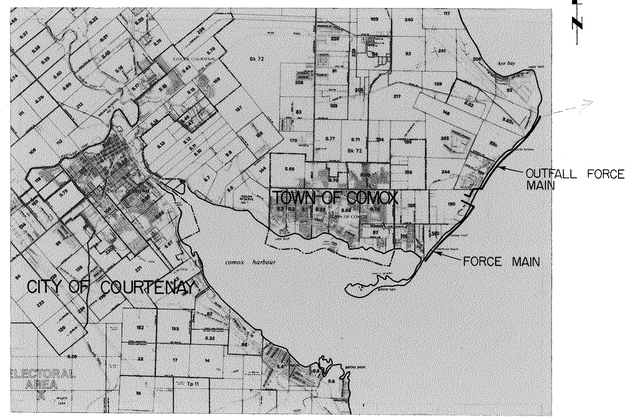
ASSOCIATED
ENGINEERING
SERVICES LTD.

COURTENAY B.C. 1982

AESL



KEY PLAN
1: 10,000



LOCATION PLAN
1: 25,000

LEGEND

PROPOSED	EXISTING
FORCE MAIN	
ACCESS HATCH	
BLOW DOWN	
POINT OF INTERSECTION (ON LINE)	
CONTROL POINT	
	EDGE OF PAVEMENT
	EDGE OF GRAVEL
	POWER POLE
	CULVERT
CATHODIC PROTECTION TEST STATION	

INDEX OF DRAWINGS

NOTES:

1. WORKING EASEMENT WIDTHS WHERE SHOWN ARE GENERAL OUTLINES ONLY. ASCERTAIN ACTUAL WORKING BOUNDARIES AND CONDITIONS PRIOR TO CONSTRUCTION FROM THE ENGINEER.
2. AT HORIZONTAL AND VERTICAL CURVES OR DEFLECTIONS WHERE NO BEND FITTINGS ARE SPECIFIED, THEY SHALL BE FORMED BY EITHER PIPE JOINT DEFLECTIONS, SKEWED ENDS OR SMALL BEND FITTINGS.
3. ALL LOCATIONS OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED BY USE OF PIPE LOCATOR AND MANUAL DIGGING. ALL OR ANY EXISTING STRUCTURES NOT NECESSARILY SHOWN.
4. ELEVATIONS ARE TO GEODETIC DATUM.
5. DIMENSIONS ARE IN METRES AND MILLIMETRES UNLESS OTHERWISE SPECIFIED.
6. PIPE DIAMETERS NOTED ON THE DRAWINGS ARE NOMINAL DIAMETERS. SEE SPECIFICATIONS FOR ACTUAL DIAMETERS.
7. COORDINATES OF ALL CONTROL POINTS, AND POINTS OF INTERSECTION SHOWN ON THE DRAWINGS SHALL BE GIVEN TO THE CONTRACTOR PROIR TO CONSTRUCTION.
8. TEMPORARY WORKING EASEMENTS FOR FORESHORE SECTIONS SHALL NOT ENCROACH ON PRIVATE PROPERTY WITHOUT THE WRITTEN CONSENT OF THE OWNER.

ASSOCIATED ENGINEERING SERVICES LTD.

DRAWING REFERENCE
METRIC

NO	DATE	BY	ENG.	SUBJECT
1	FEB '83			AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

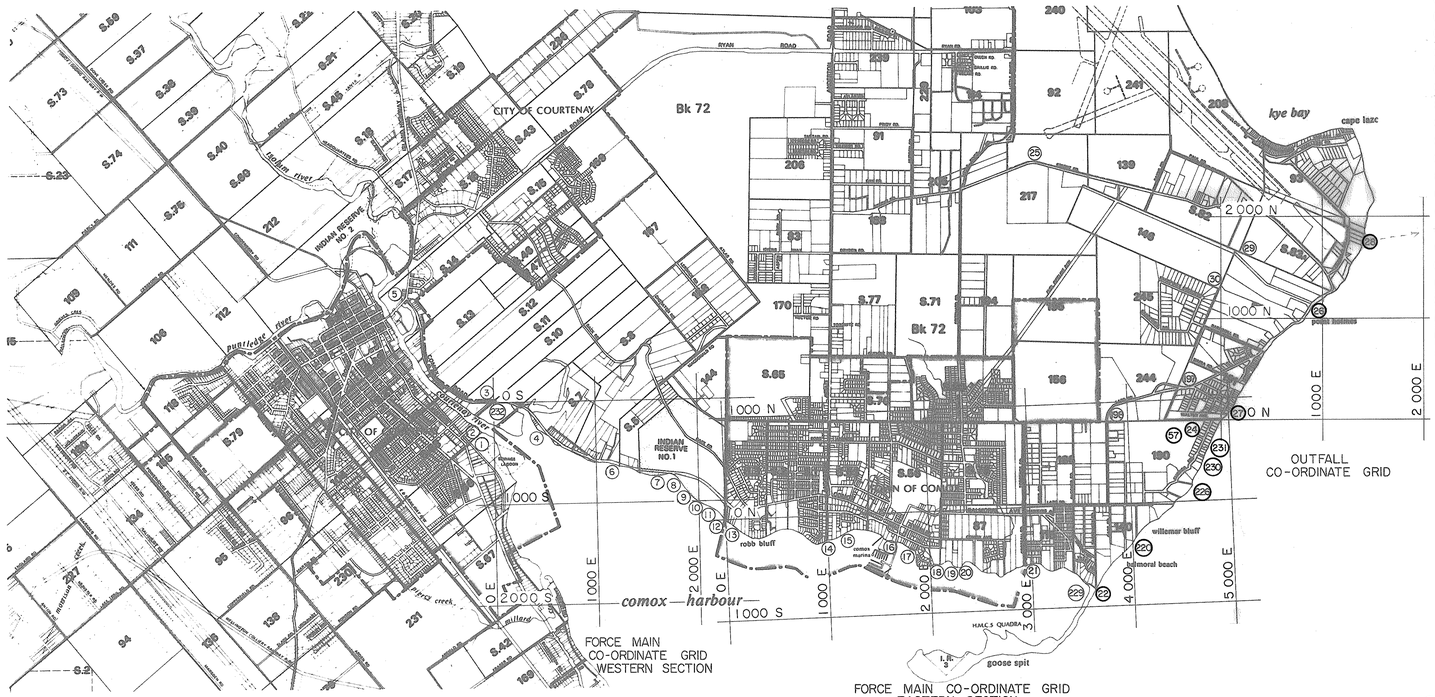
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

KEY PLAN

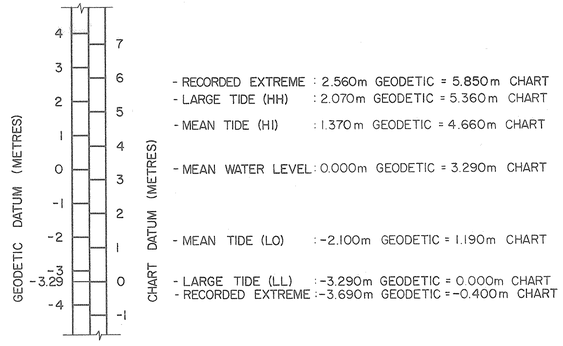
DRAWING NUMBER	REV	SHEET
V41E-S7-21-101	1	1/15



CO-ORDINATE GRID SYSTEMS AND BENCH MARK PLAN

SCALE : 1:25 000

BM No.	ELEV.	DESCRIPTION
1	7.179	GEODETIC # 77-C-511 AT COURTENAY TOURIST BUREAU
2	4.257	SOUTH NUT ON HYDRANT ; NORTH SIDE 20TH STREET AT MARINA
3	3.667	ARROWHEAD ON HYDRANT ; NORTH SIDE COMOX RD. ; WEST OF 20TH STREET
4	2.867	GEODETIC # 77-C-501 AT CEMENT SILO
5	3.552	GEODETIC # 77-C-500 AT COMOX VALLEY FORD
6	3.842	N.W. CORNER OF CONCRETE SLAB AT DOUBLE WIDE DOORS ; PORTUGUESE JOE'S FISH MARKET
7	5.650	ARROWHEAD ON HYDRANT 3210 COMOX RD.
8	5.676	ARROWHEAD ON HYDRANT 3340 COMOX RD.
9	6.530	GEODETIC # 77-C-520 RED HOUSE ON INDIAN RESERVE AT BOTTOM OF COMOX RD.
10	4.989	ARROWHEAD ON HYDRANT AT TURQUOISE HOUSE ON INDIAN RESERVE
11	5.182	ARROWHEAD ON HYDRANT 3720 HOUSE ON INDIAN RESERVE
12	2.817	MON. ABOVE HIGH WATER MARK AT EAST LIMIT OF INDIAN RESERVE
13	2.667	S.W. CORNER ; TOP OF ABANDONED CONCRETE MH AT HWM (OLD 150mm DIA. STEEL DRAIN)
14	1.777	N. MANHOLE RIM ; HIGH WATER MARK AT CARTHEW ST.
15	1.185	N. MANHOLE RIM ; GREY-GREEN HOUSE ; SOUTH OF STONE WALL
16	6.323	GEODETIC # 77-C-506 ON WATER VALVE CHAMBER ; FOOT OF PORT AUGUSTA ST.
17	3.204	NAIL IN NORTH BRICKWALL ; ENTRANCE TO COMOX SEWAGE PUMP STATION
18	2.608	"X" IN RIM OF MANHOLE # 8
19	2.168	"X" IN RIM OF MANHOLE # 9
20	2.013	"X" IN RIM OF MANHOLE # 10
21	2.911	IRON ROD IN CONCRETE BLOCK AT HWM ; EAST LIMIT OF CROTEAU RD.
22	3.786	ROUND IRON BAR AT HWM ; EAST LIMIT OF SANDCLIFFE RD.
23		
24	3.127	S.I.P. ; W. SIDE CURTIS RD. ; OPPOSITE BEACH ACCESS RD.
25	13.893	PIPE SET IN CONCRETE ; ℄ ENTRANCE GATE AT C.F.B. COMOX TREATMENT PLANT
26	4.131	MON. ON LAZO RD. ABOVE HWM ; 140±m SOUTH OF BOAT RAMP ; LOT 230
27	3.678	S.I.P. INTERSECTION RADFORD RD. & ANDREW RD.
28	3.861	NAIL IN BASE OF 500mm DIA. BALSAM ABOVE HWM ; LOT B PLAN 20444 AT BEACH HOUSE
29	3.080	I.P. N.E. CORNER D.L. 146
30	4.230	I.P. S.E. CORNER D.L. 146
197	8.483	S.I.P. INTERSECTION LAZO RD. & BRENT RD.
198	26.521	S.I.P. INTERSECTION LAZO RD. AT ℄ NOEL EXTENSION
224	1.163	L.P. IN SADDLE SHAPE GREY ROCK IN GRAVEL
226	1.369	L.P. IN FLAT GRANITE ROCK
229	2.056	S.I.P. AT TH 302
232	3.000	S.I.P. S. SIDE COMOX RD. ; ℄ 20TH STREET
231	3.341	S.I.P. W. SIDE CURTIS RD. ; @ 12.19 WIDE ROAD ALLOWANCE ; W.P.C.C. OUTLET
230	5.390	NAIL IN FENCE POST, S.E. CORNER LOT 10, PLAN 4167
57	12.079	IRON ROD IN 600x600 CONCRETE PAD AT W.P.C.C. ; 134 N / 200W



- RECORDED EXTREME : 2.560m GEODETIC = 5.850m CHART
- LARGE TIDE (HH) : 2.070m GEODETIC = 5.360m CHART
- MEAN TIDE (HI) : 1.370m GEODETIC = 4.660m CHART
- MEAN WATER LEVEL : 0.000m GEODETIC = 3.290m CHART
- MEAN TIDE (LO) : -2.100m GEODETIC = 1.190m CHART
- LARGE TIDE (LL) : -3.290m GEODETIC = 0.000m CHART
- RECORDED EXTREME : -3.690m GEODETIC = -0.400m CHART

BENCHMARK DATUM PLANES & TIDE LEVELS

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG	SUBJECT
2	FEB.'83			AS CONSTRUCTED
1	JUNE'82			BENCHMARKS ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:25 000
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

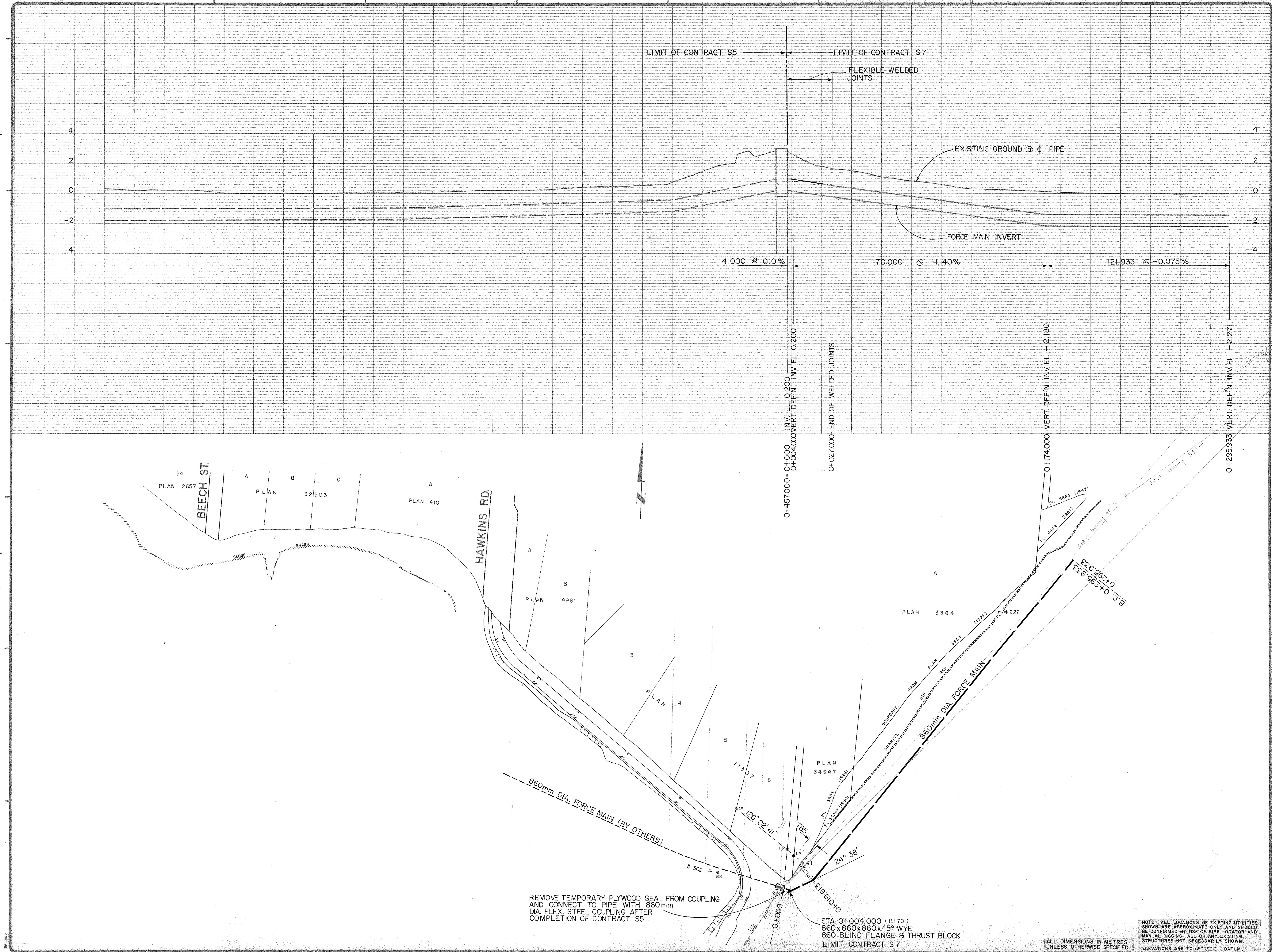
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R.W. SHARP

REGIONAL DISTRICT OF COMOX-STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

CO-ORDINATE SYSTEMS AND BENCH MARKS

DRAWING NUMBER	REV	SHEET
V41E-S7-21-102	2	2/15



ASSOCIATED ENGINEERING SERVICES LTD.
AESL

DRAWING REFERENCE
= METRIC =

NO	DATE	BY	ENG	SUBJECT
2	FEB.'83			AS CONSTRUCTED
1	JUNE '82			CONTROL ADDED

REVISIONS

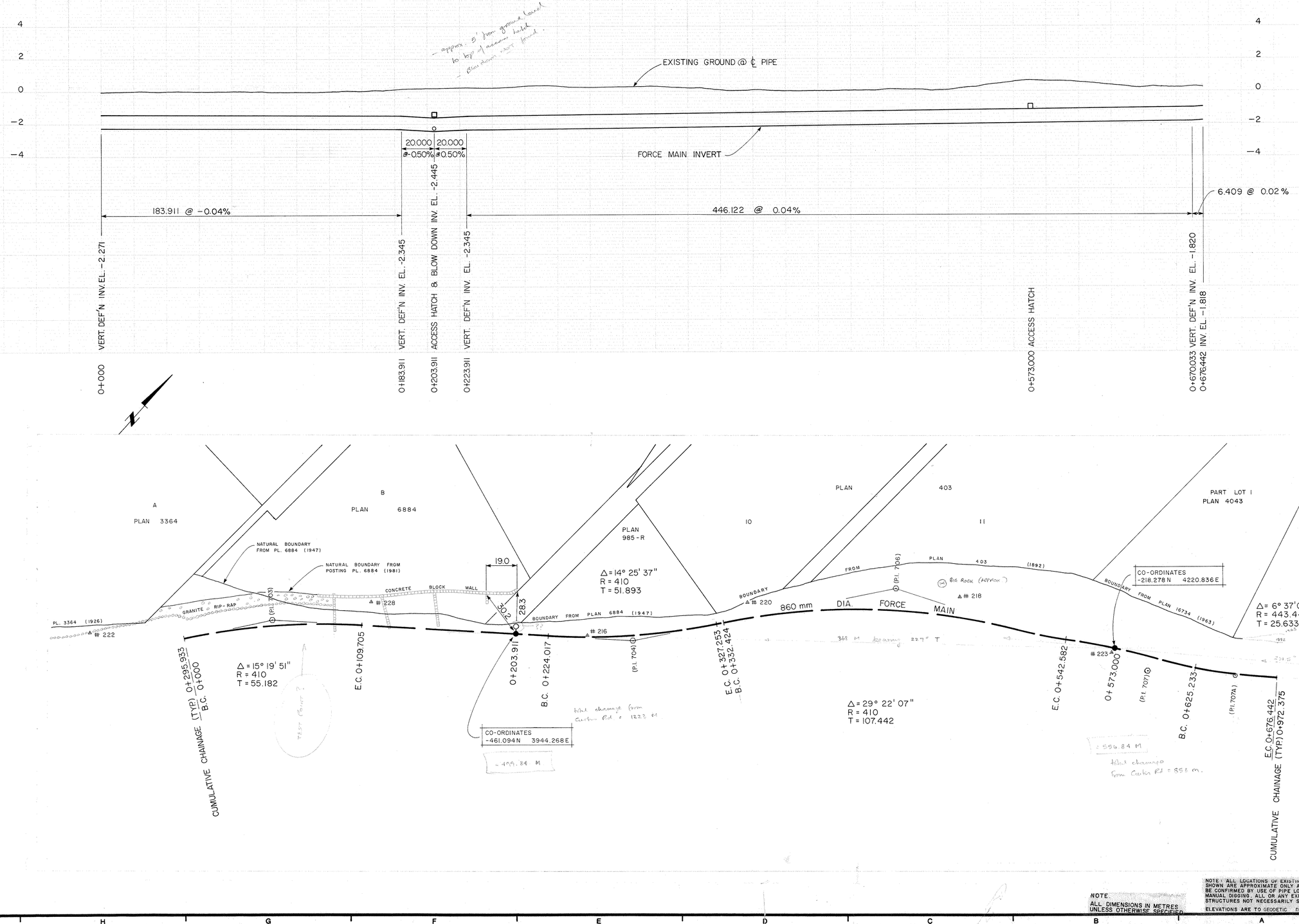
JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

FORCE MAIN PLAN & PROFILE GOOSE SPIT RD. & FORESHORE

DRAWING NUMBER	REV	SHEET
V41E-S7-21-103	2	3/15



NOTE:
ALL DIMENSIONS IN METRES UNLESS OTHERWISE SPECIFIED.

NOTE: ALL LOCATIONS OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED BY USE OF PIPE LOCATOR AND MANUAL DIGGING. ALL OR ANY EXISTING STRUCTURES NOT NECESSARILY SHOWN. ELEVATIONS ARE TO GEODETIC DATUM.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
2	NOV '82			AS CONSTRUCTED
1	JUNE '82			CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL , 1982

STAMPS

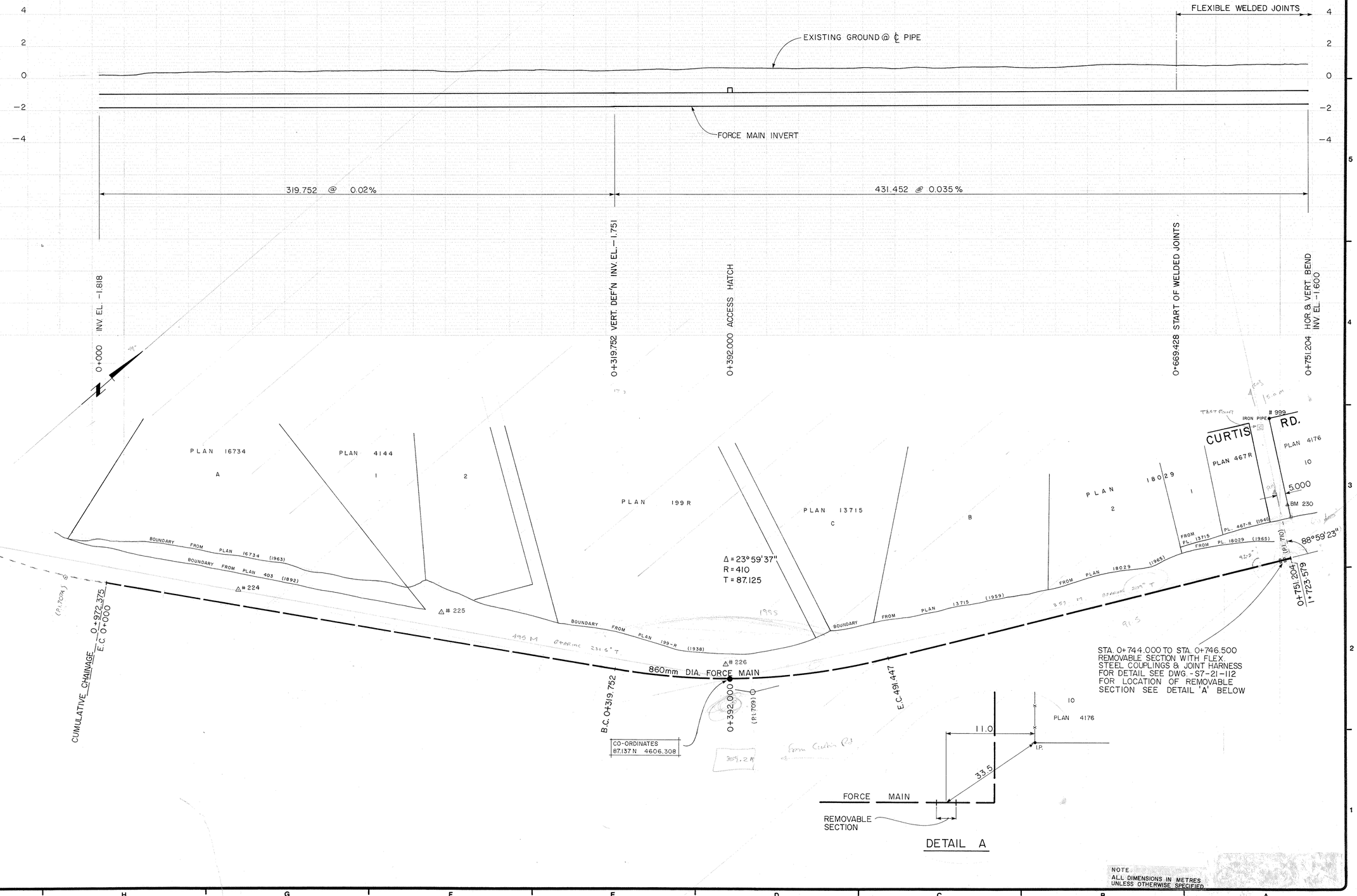
CLIENT
REGIONAL DISTRICT OF COMOX-STRATHCONA

LOCATION
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S 7

PROJECT

SUBJECT
FORCE MAIN PLAN & PROFILE FORESHORE

DRAWING NUMBER	REV	SHEET
V41E-S7-21-104	2	4/15



ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
2	JUNE '83			AS CONSTRUCTED
1	JUNE '82			CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	

STAMPS

PROFESSIONAL ENGINEER R. W. SHARP BRITISH COLUMBIA

CLIENT

REGIONAL DISTRICT OF COMOX - STRATHCONA

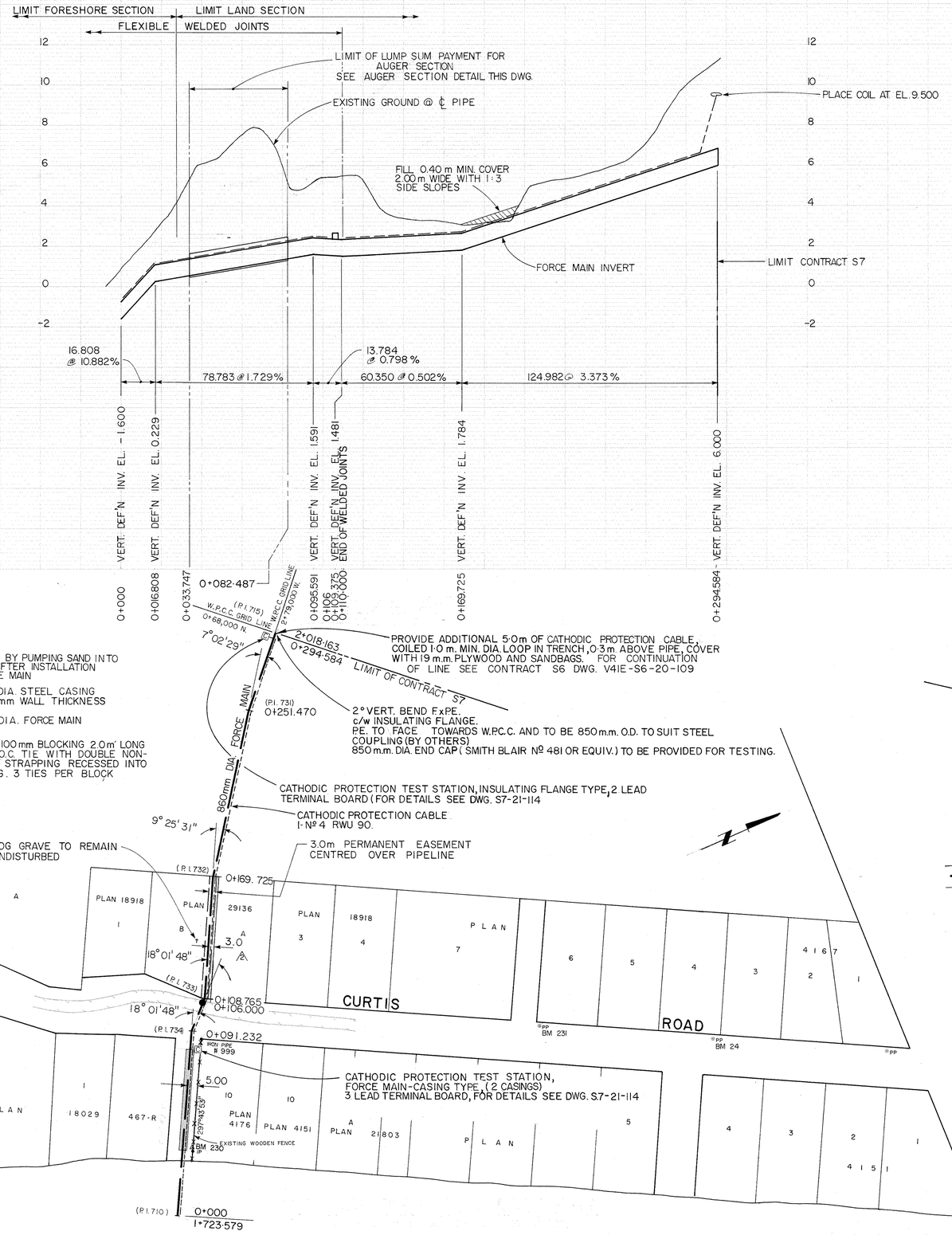
PROJECT

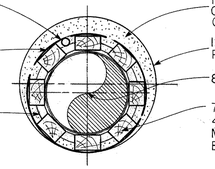
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

SUBJECT

FORCE MAIN PLAN & PROFILE FORESHORE

DRAWING NUMBER	REV	SHEET
V41E-S7-21-105	2	5/15





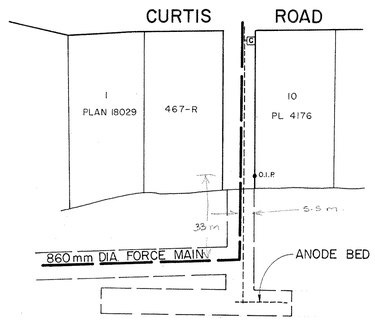
AUGER SECTION DETAIL

SCALE: N.T.S.

NOTES: 1. NON-METALLIC STRAPPING SHALL BE 19m.m. WIDE, HEAVY DUTY POLYPROPYLENE.

2. FORCE MAIN AND CASING PIPE MUST NOT BE IN CONTACT AND NO METALIC MATERIALS SHALL BE USED INSIDE THE CASING.

3. ALTERNATIVELY TO CEDAR BLOCKING M-2 PLASTIC THINSULATOR (T.D. WILLIAMSON INC., TULSA, OKLA.) MAY BE USED. MAX. ℄ SPACING 2.4 m.



ANODE BED LOCATION

NOTE. ALL DIMENSIONS IN METRES UNLESS OTHERWISE SPECIFIED.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
3	JUNE'83	JM	RS	AS CONSTRUCTED
2	SEPT.'82	JM	RS	FORCE MAIN REALIGNED
1	JUNE'82	JM	RS	CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	JM
DESIGNED	
CHECKED	Bowman
APPROVED	Sharp
APPROVED	
DATE	

STAMPS

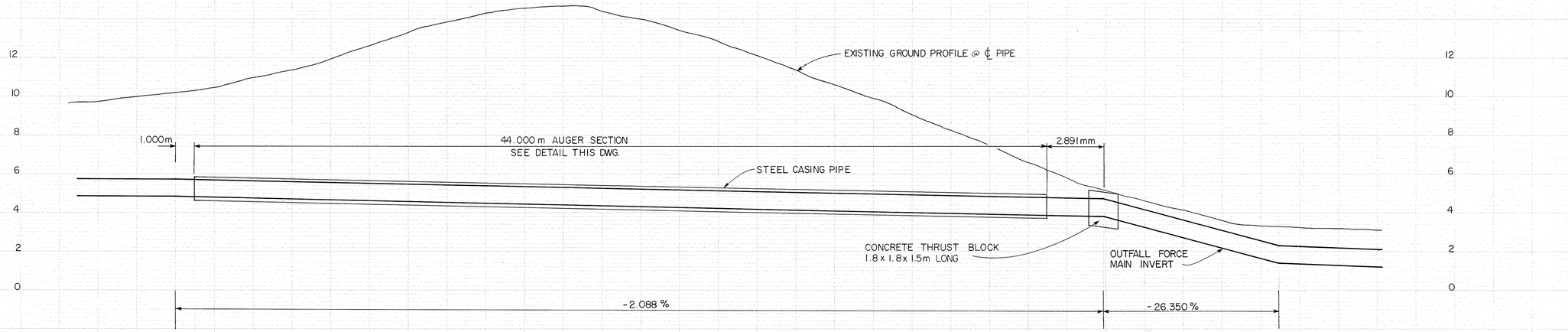
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R.W. SHARP

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

PROJECT
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

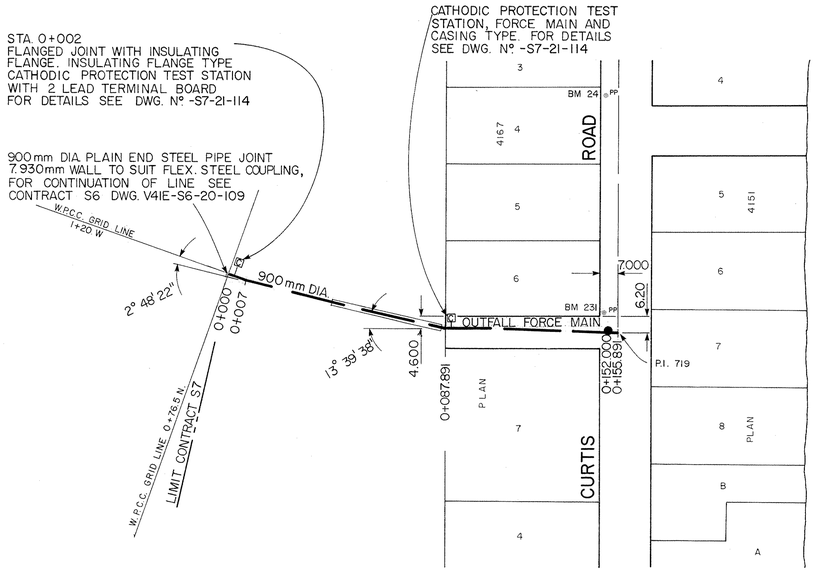
SUBJECT
FORCE MAIN PLAN & PROFILE FORESHORE TO W.P.C.C.

DRAWING NUMBER	REV	SHEET
V41E-S7-21-106	3	6/15

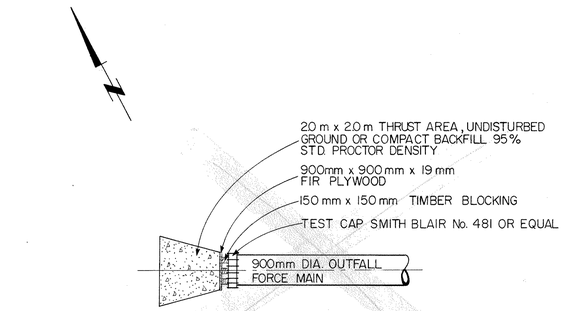


DETAIL PROFILE STA. 0+040.000 TO 0+097.000

SCALE = HOR. 1:100
VERT. 1:100

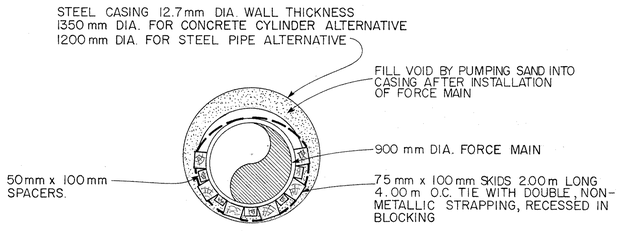


SCALE = 1:1000



TEMPORARY THRUST BLOCK DETAIL AT STA. 0+000

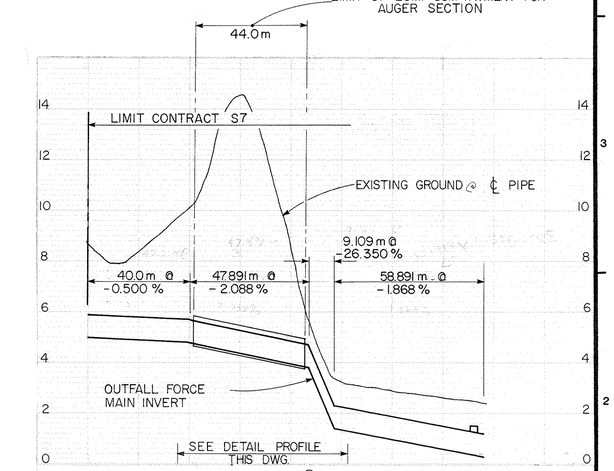
SCALE : N.T.S.



DETAIL OF AUGER SECTION

SCALE : N.T.S.

SEE NOTES FOR AUGER SECTION DETAIL DWG. - S7-21-106



SCALE : HOR. 1:1000
VERT. 1:100

NOTE.
ALL DIMENSIONS IN METRES
UNLESS OTHERWISE SPECIFIED.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡ METRIC ≡

NO	DATE	BY	ENG.	SUBJECT
2	FEB '83			AS CONSTRUCTED
1	JUNE '82			CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

STAMPS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R. W. SHARP REGISTERED PROFESSIONAL ENGINEER

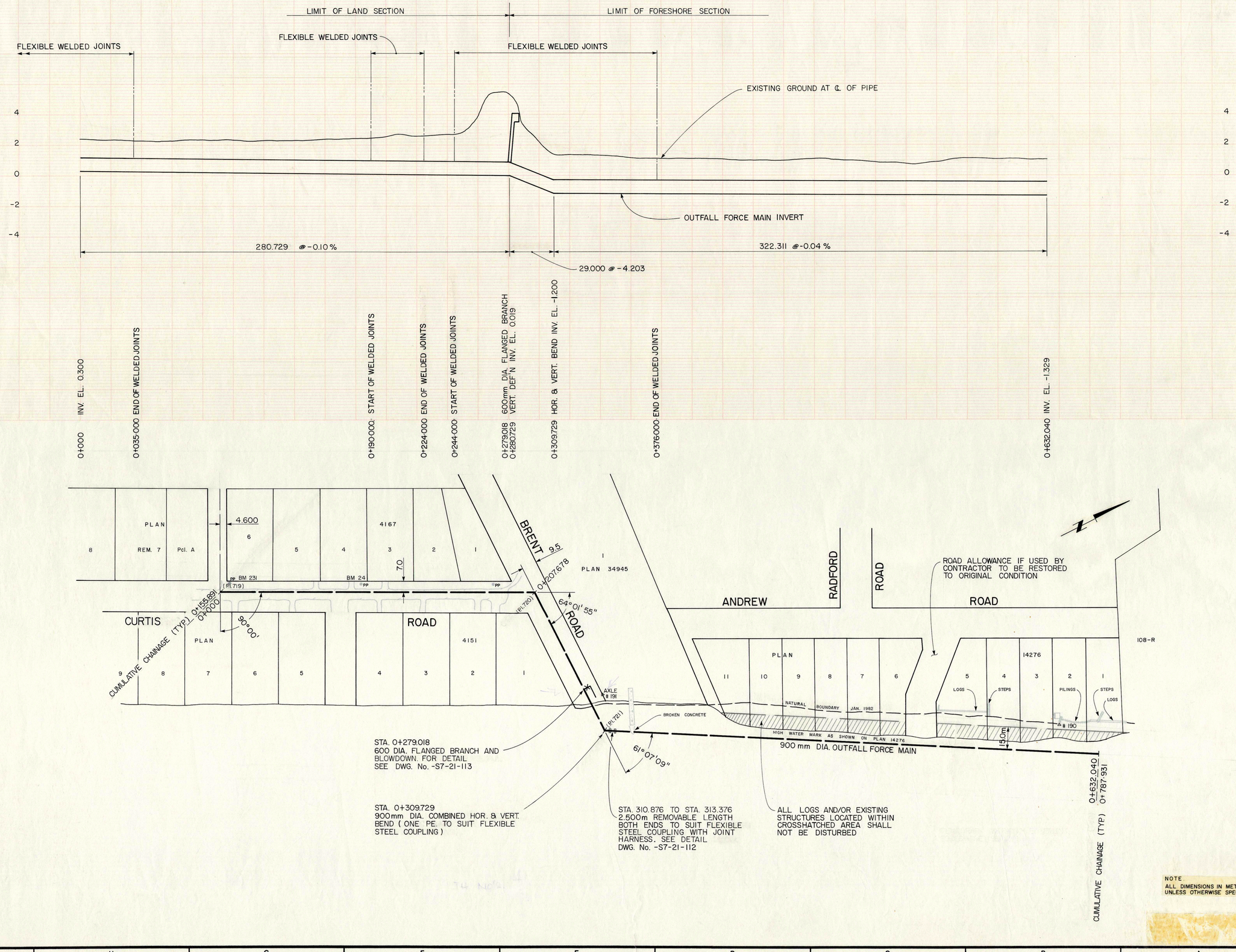
CLIENT
REGIONAL DISTRICT OF
COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

PROJECT

SUBJECT
OUTFALL PLAN & PROFILE
W.P.C.C. TO CURTIS RD.

DRAWING NUMBER	REV	SHEET
V41E-S7-21-107	2	7/15



NOTE
ALL DIMENSIONS IN METRES UNLESS OTHERWISE SPECIFIED.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡ METRIC ≡

NO	DATE	BY	ENG.	SUBJECT
2	FEB. '83	JM	RS	AS CONSTRUCTED
1	JUNE '82	JM	RS	CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	

STAMPS

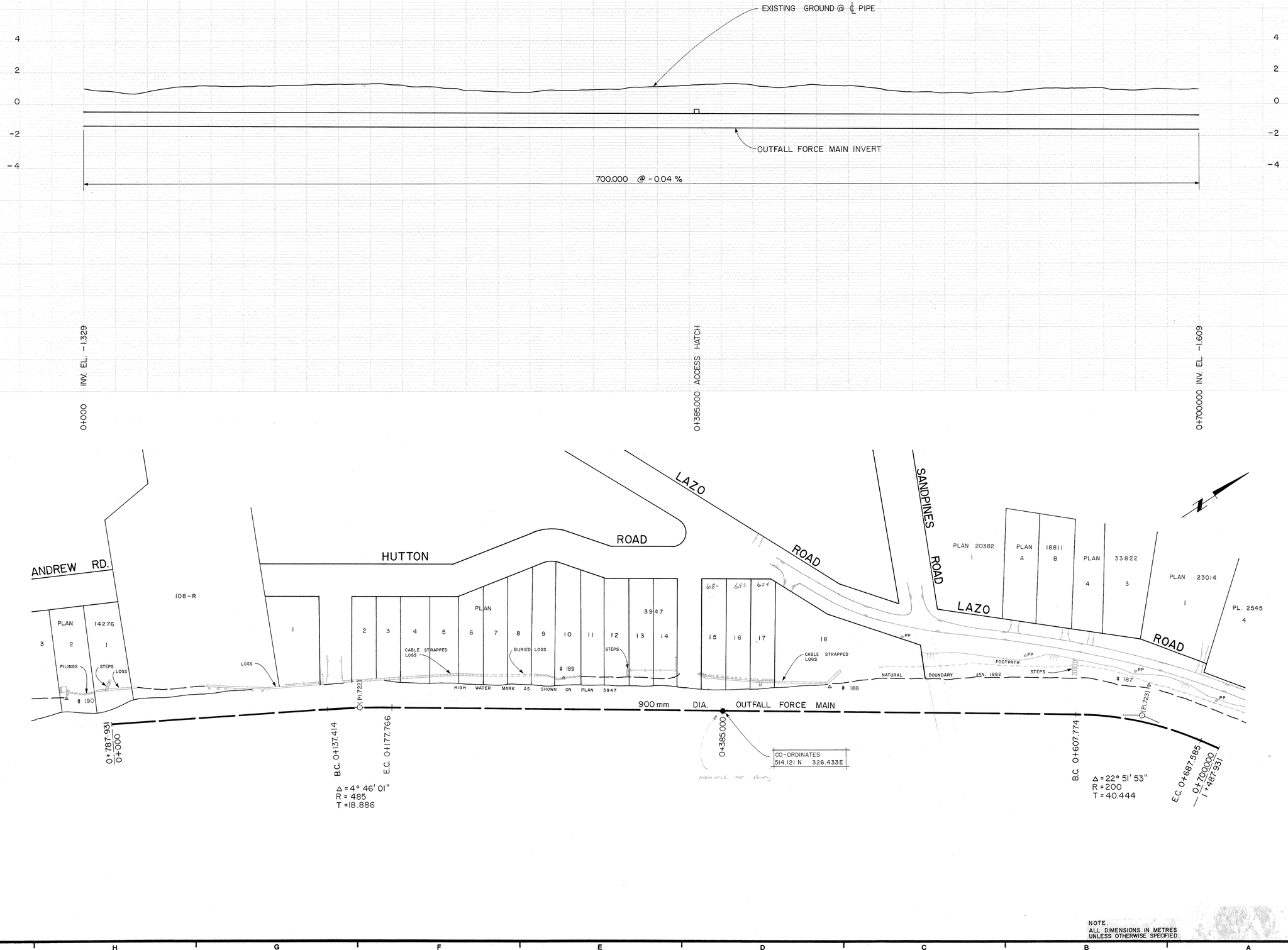
PROFESSIONAL ENGINEER OF BRITISH COLUMBIA R. W. SHARP

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

PROJECT
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

SUBJECT
OUTFALL PLAN & PROFILE CURTIS RD., BRENT RD. & FORESHORE

DRAWING NUMBER	REV	SHEET
V41E-S7-21-108	2	8/15



NOTE.
ALL DIMENSIONS IN METRES
UNLESS OTHERWISE SPECIFIED.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
2	OCT.'82	JM	RB	AS CONSTRUCTED
1	JUNE '82		JM	CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	JM
DESIGNED	[illegible]
CHECKED	R. Sharp
APPROVED	
APPROVED	
DATE	APRIL 1982

STAMPS

R. W. SHARP REGISTERED PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

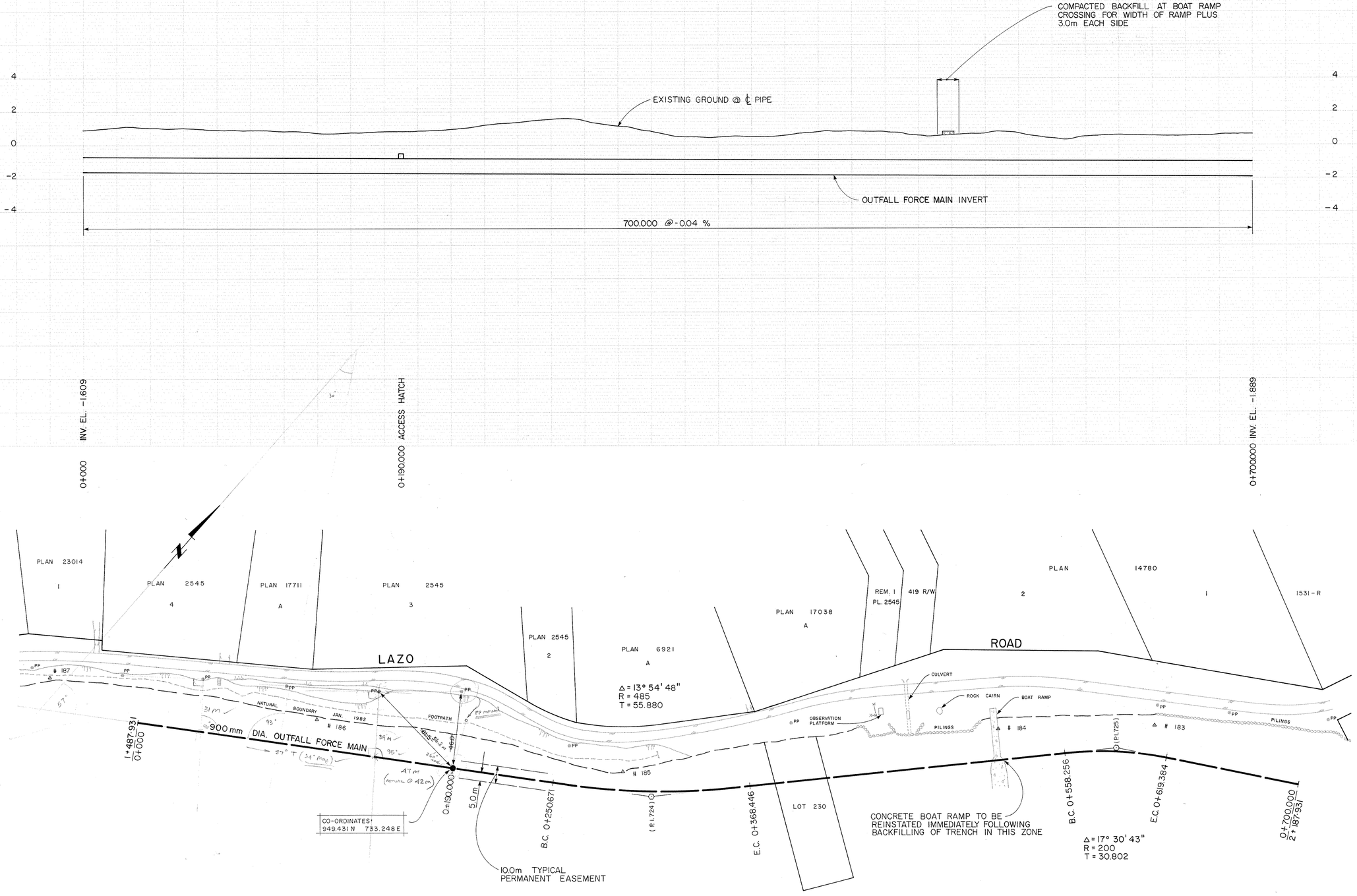
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

PROJECT

SUBJECT
OUTFALL PLAN & PROFILE FORESHORE

DRAWING NUMBER	REV	SHEET
V41E-S7-21-109	2	9/15

BY REGT



NOTE.
ALL DIMENSIONS IN METRES UNLESS OTHERWISE SPECIFIED.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
2	OCT.'82	AM	WWD.	AS CONSTRUCTED
1	JUNE '82	AM	WWD.	CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	AM
DESIGNED	WWD
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

STAMPS

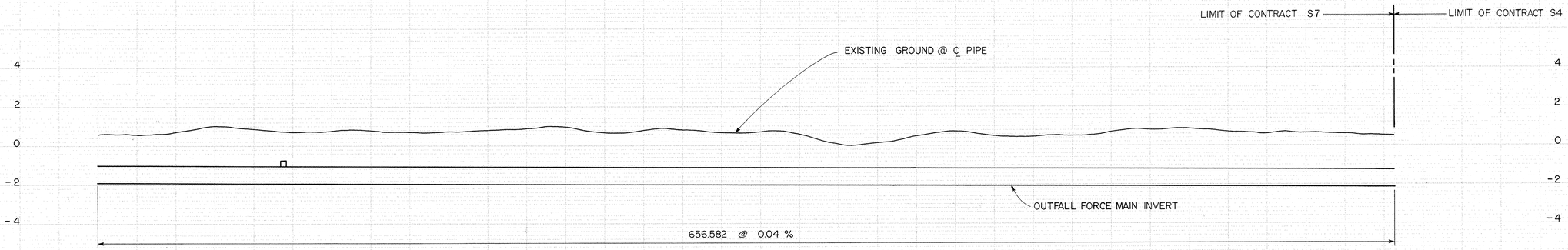
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R.W. SHARP

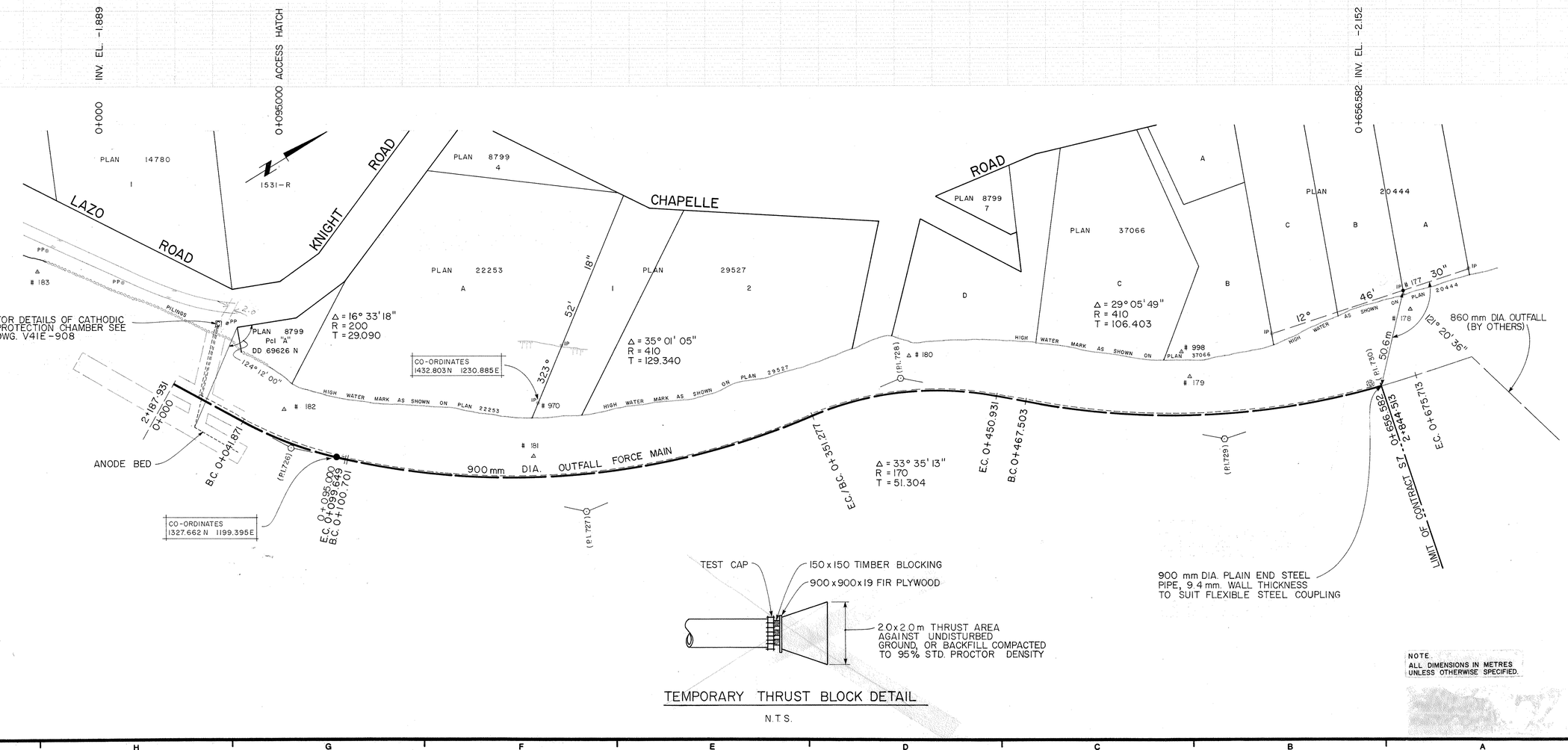
CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7
PROJECT

SUBJECT
OUTFALL PLAN & PROFILE FORESHORE

DRAWING NUMBER	REV	SHEET
V41E-S7-21-110	2	10/15





ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
2	JUNE '83			AS CONSTRUCTED
1	JUNE '82			CONTROL ADDED

REVISIONS

JOB NUMBER	V41E
SCALE	1:1000 HOR. 1:100 VERT.
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

STAMPS

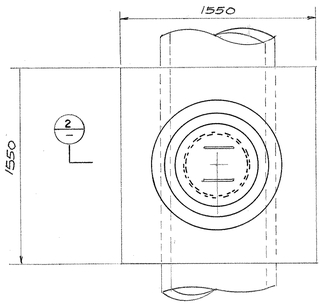
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R. W. SHARP

CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

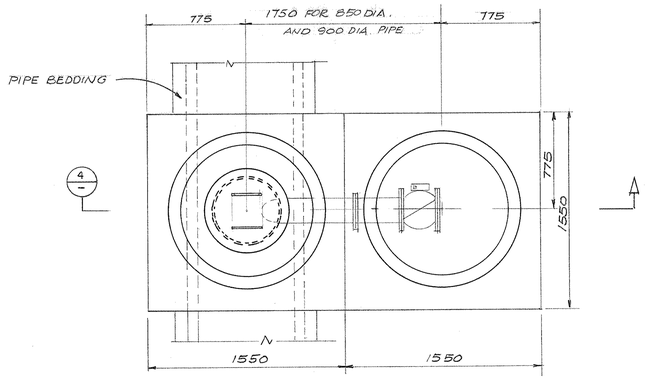
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7
PROJECT

SUBJECT
OUTFALL PLAN & PROFILE FORESHORE

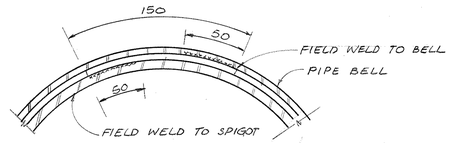
DRAWING NUMBER	REV	SHEET
V41E-S7-21-111	2	11/15



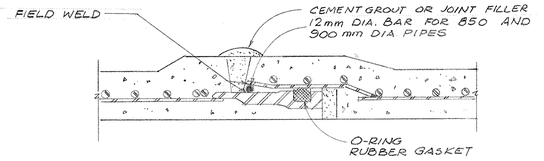
PLAN AT 1



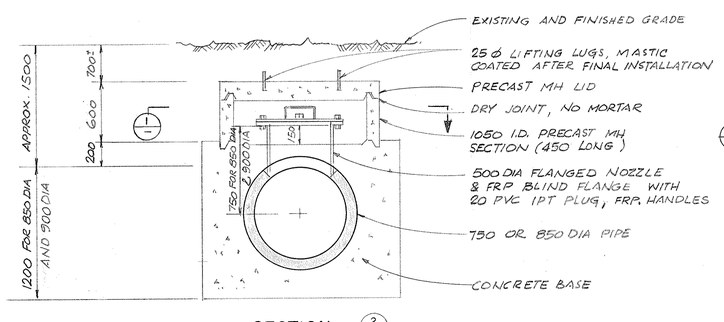
PLAN AT 3



TYPICAL SECTION

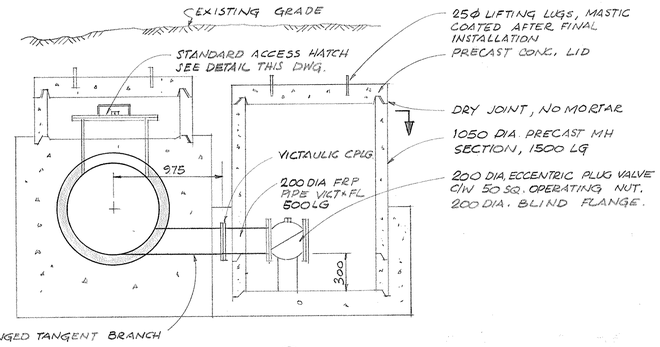


CONCRETE CYLINDER PIPE



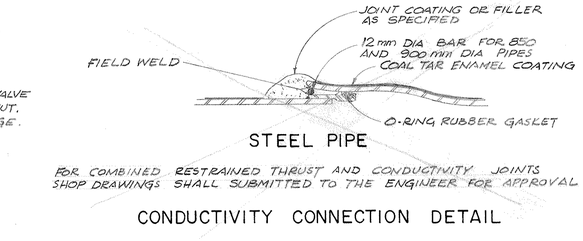
SECTION 2
ACCESS HATCH DETAIL

1:20



SECTION 4
BLOW DOWN DETAIL

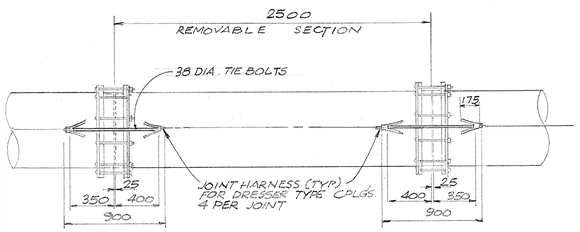
1:20

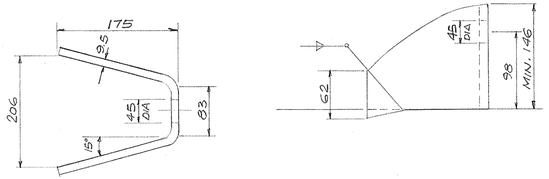


STEEL PIPE

FOR COMBINED RESTRAINED THRUST AND CONDUCTIVITY JOINTS SHOP DRAWINGS SHALL SUBMITTED TO THE ENGINEER FOR APPROVAL

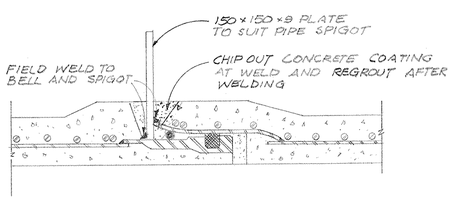
CONDUCTIVITY CONNECTION DETAIL





REMOVABLE SECTION DETAIL

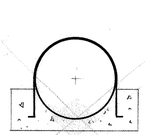
N.T.S.



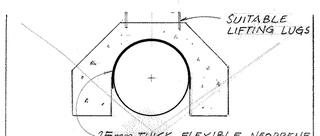
CONCRETE CYLINDER PIPE
TEST POINT TERMINAL PLATE DETAIL

N.T.S.

PIPE ANCHORING REQUIREMENTS AND ALTERNATIVES FOR STEEL PIPE IN FORESHORE SECTION

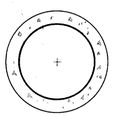


CONTINUOUS OR INTERMITTENT CONCRETE BEDDING WITH APPROVED TIE DOWN BARS WITH MAX. SPACING OF 12.2m SEE NOTE 2



25mm THICK FLEXIBLE NEOPRENE SHEET STRAPPED TO PIPE, SHEETS TO EXTEND 100mm BELOW PIPE ℄ AND 100 mm PAST EACH BLOCK

PRECAST CONC. ANCHOR BLOCK WITH CENTRE OF GRAVITY BELOW PIPE ℄ MAX. SPACING 12.2m SEE NOTE 2



CONTINUOUS OR INTERMITTENT CONC. COATING WITH MIN. THICKNESS 70mm FOR ALL PIPE SIZES. CENTER TO CENTER INTERVALS SHALL NOT EXCEED 12.2m.

CONCRETE BEDDING, PRECAST CONC. ANCHOR BLOCK OR CONCRETE COATING WEIGHT

LOCATION	PIPE DIA	WEIGHT TO BE ADDED kg/m (WEIGHT IN AIR)
OUTER HARBOUR (EAST OF GOOSE SPIT ROAD)	850 mm	64
	900 mm	153

NOTES:

1. AT HORIZ. BENDS 22½° AND OVER, WYE FITTINGS, REMOVABLE PIPE SECTIONS AND ACCESS HATCHES ADDITIONAL ANCHORING EQUIVALENT TO ONE UNIT OF THE SELECTED ALTERNATIVE METHOD SHALL BE INSTALLED
2. SHOP DRAWINGS SHOWING DIMENSIONS AND REINFORCING SHALL BE SUBMITTED TO THE ENGINEER FOR APPROVAL.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
1	FEB.'83			AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	D.W.
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

STAMPS

REGISTERED PROFESSIONAL ENGINEER OF B.C. R.W. SHARP 5097 ENGINEER

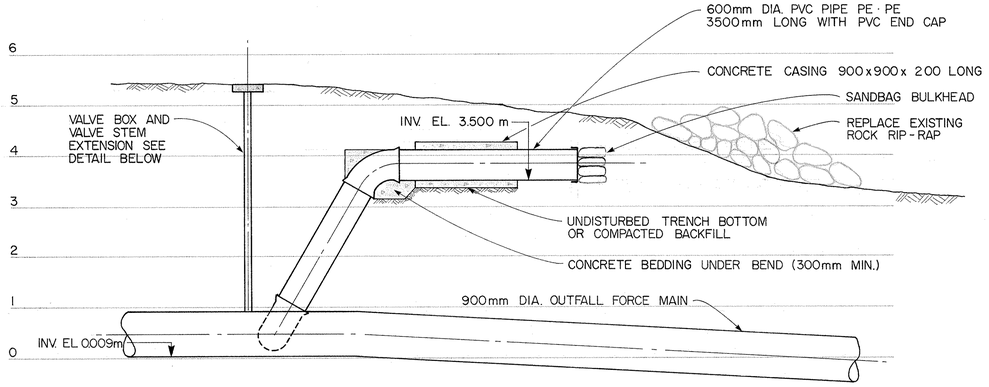
CLIENT
REGIONAL DISTRICT OF COMOX - STRATHCONA

PROJECT
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

SUBJECT
SPECIAL STRUCTURES & FITTINGS

DRAWING NUMBER	REV	SHEET
V41E-S7-21-112	1	12/15

BP - 0881

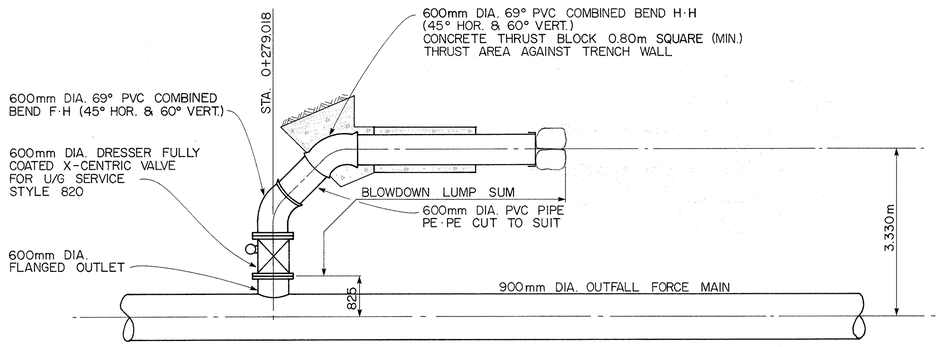


ELEVATION

SCALE: 1:50

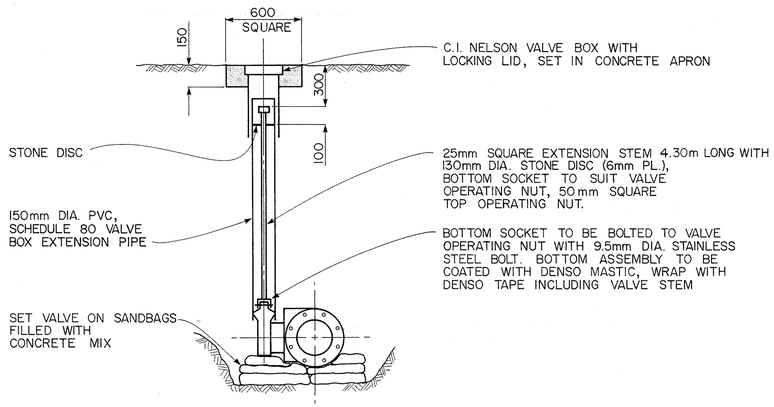
NOTE:

600mm DIA. PVC PIPE TO BE SDR41
AS SUPPLIED BY SCEPTER



PLAN

SCALE: 1:50



DETAIL

VALVE BOX & VALVE STEM EXTENSION

SCALE: N.T.S.

NOTE:
ALL DIMENSIONS IN MILLIMETRES
UNLESS OTHERWISE SPECIFIED.

NOTE: ALL LOCATIONS OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED BY USE OF PIPE LOCATOR AND MANUAL DIGGING. ALL OR ANY EXISTING STRUCTURES NOT NECESSARILY SHOWN.
ELEVATIONS ARE TO GEODETIC DATUM.

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

≡ METRIC ≡

NO	DATE	BY	ENG.	SUBJECT
1	FEB '83			AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL 1982

STAMPS

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA R.W. SHARP

CLIENT

REGIONAL DISTRICT OF COMOX - STRATHCONA

PROJECT

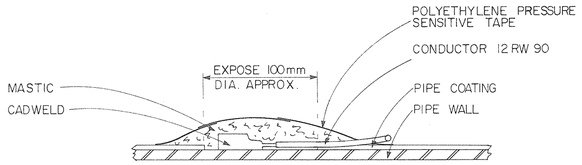
REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

SUBJECT

BLOWDOWN DETAILS

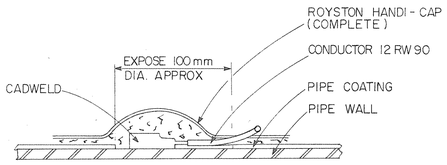
DRAWING NUMBER	REV	SHEET
V41E-S7-21-113	1	13/15

BP - 6881



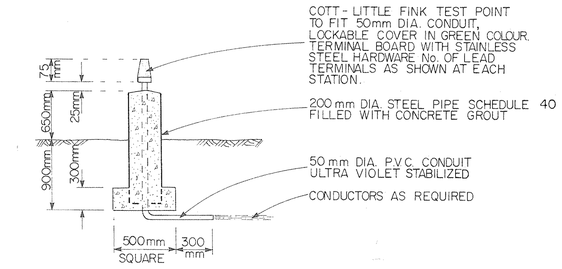
CADWELD COVERED BY MASTIC & TAPE

SCALE : N.T.S.



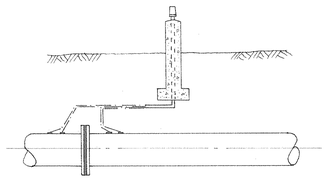
CADWELD COVERED BY HANDI-CAP

SCALE : N.T.S.

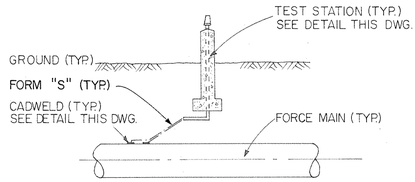


TYPICAL TEST STATION DETAIL

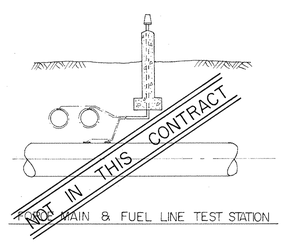
SCALE : N.T.S.



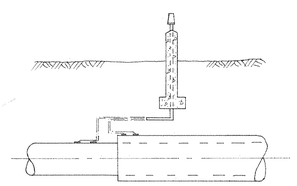
FORCE MAIN & INSULATING FLANGE



SINGLE PIPE LINE TEST STATION (SINGLE LINE TWO LEAD TYPE)



FORCE MAIN & FUEL LINE TEST STATION



FORCE MAIN & CASING TEST STATION

TYPICAL TEST STATION LAYOUTS

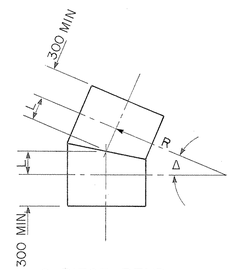
SCALE : N.T.S.

NOTE :

1. DOUBLE CONDUCTORS FOR EACH PIPE, EACH WITH ITS OWN WELD. CONDUCTORS TO BE COLOUR CODED :

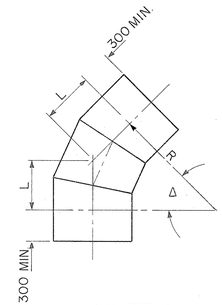
FORCE MAIN	BLACK
CASING PIPE	RED

2. CATHODIC PROTECTION TEST LEADS SHALL BE No. 12 RW 90 CABLE
3. CONDUCTORS TO BE STRAPPED TO PIPE OUTSIDE OF CADWELD PATCH WITH No. 425 POLYBAND, FORM HORIZONTAL S, 600mm DIA. RADIUS EACH HALF AT PIPE AND AT BOTTOM OF TEST STATION.



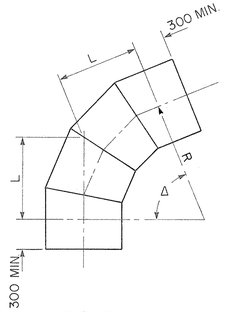
2 PIECE BEND

(0° TO 20°)



3 PIECE BEND

(20° TO 45°)

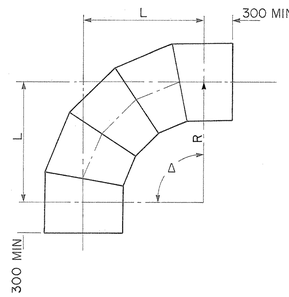


4 PIECE BEND

(45° TO 65°)

TABLE OF 'L' VALUES				
PIPE DIA.	2 PIECE	3 PIECE	4 PIECE	5 PIECE
750	264.5	621.3	955.6	1500.0
860	303.3	712.5	1095.8	1720.0
900	317.4	754.6	1146.7	1800.0

NOTE : FOR ALL BENDS $R = \frac{L}{\tan \frac{\Delta}{2}}$



5 PIECE BEND

(65° TO 90°)

NOTE : ALL DIMENSIONS ARE IN MILLIMETRES

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

DRAWING REFERENCE

= METRIC =

NO	DATE	BY	ENG.	SUBJECT
1	FEB.'83			AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	AS SHOWN
DRAWN	P.J.
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

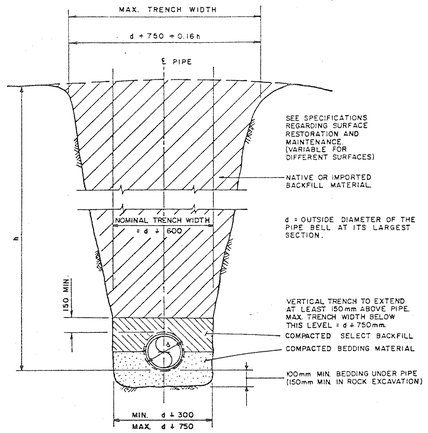
REGIONAL DISTRICT OF COMOX-STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

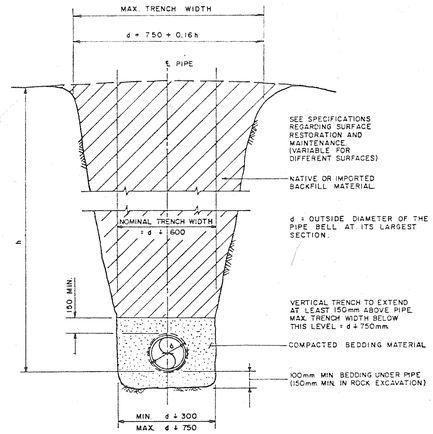
BENDS & CATHODIC TEST STATION DETAILS

DRAWING NUMBER	REV	SHEET
V41E-S7-21-114	1	14/15

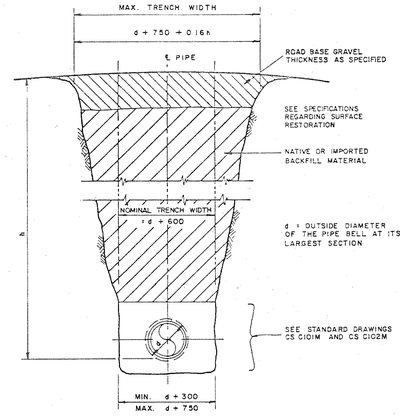
BP - 4091



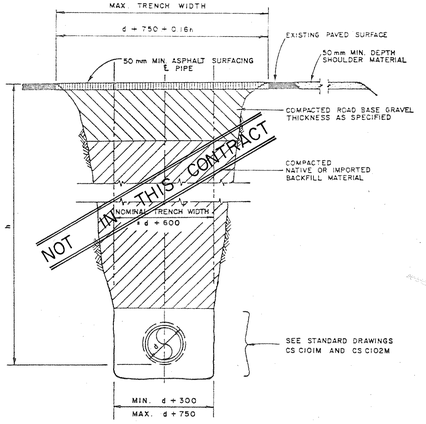
STANDARD SECTION
(PIPE MATERIALS OTHER THAN PVC)
CS C101M



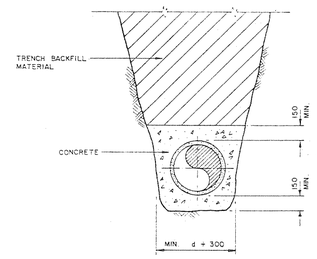
SECTION FOR PVC PIPE
CS C102M



SECTION IN GRAVELLED SURFACE
CS C103M

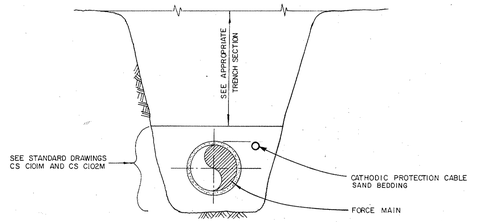


SECTION IN PAVED SURFACE
CS C104M



d = OUTSIDE DIAMETER OF PIPE AT ITS LARGEST SECTION

CONCRETE ENCASEMENT - NON REINFORCED
CS C106M



TYPICAL LOCATION OF CATHODIC PROTECTION CABLE

NOTE : ALL LOCATIONS OF EXISTING UTILITIES SHOWN ARE APPROXIMATE ONLY AND SHOULD BE CONFIRMED BY USE OF PIPE LOCATOR AND MANUAL DIGGING. ALL OR ANY EXISTING STRUCTURES NOT NECESSARILY SHOWN.
ELEVATIONS ARE TO GEODETIC DATUM.

NOTE.
ALL DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.

ASSOCIATED ENGINEERING SERVICES LTD.
AESL

DRAWING REFERENCE

METRIC

NO	DATE	BY	ENG.	SUBJECT
1	FEB.'83			AS CONSTRUCTED

REVISIONS

JOB NUMBER	V41E
SCALE	NOT TO SCALE
DRAWN	
DESIGNED	
CHECKED	
APPROVED	
APPROVED	
DATE	APRIL, 1982

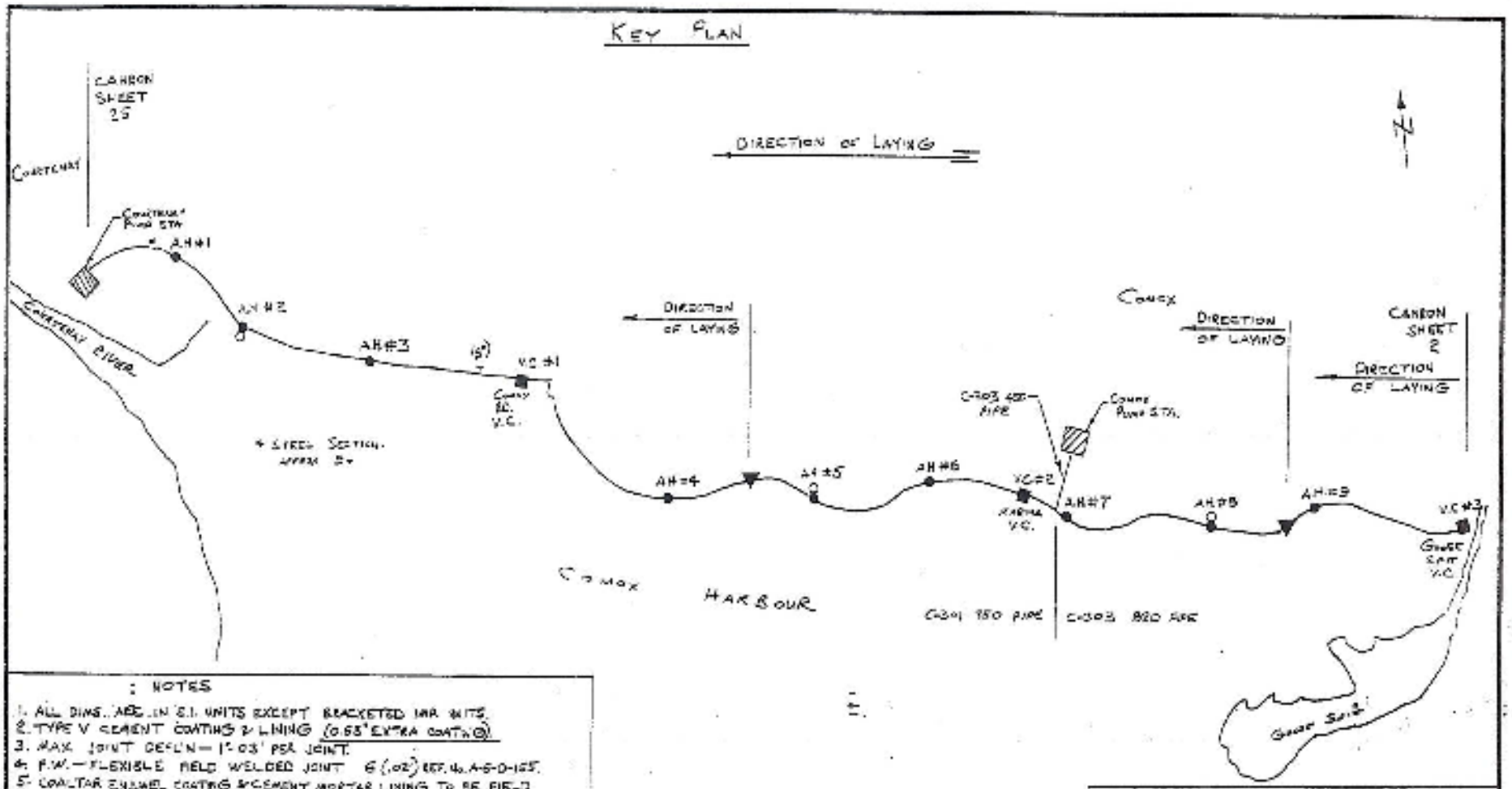
REGIONAL DISTRICT OF COMOX - STRATHCONA

REGIONAL SEWERAGE SYSTEM
SEWAGE FORCE MAIN
GOOSE SPIT TO CAPE LAZO
CONTRACT S7

TRENCH DETAILS

DRAWING NUMBER	REV	SHEET
V41E-S7-21-115	1	15/15

KEY PLAN



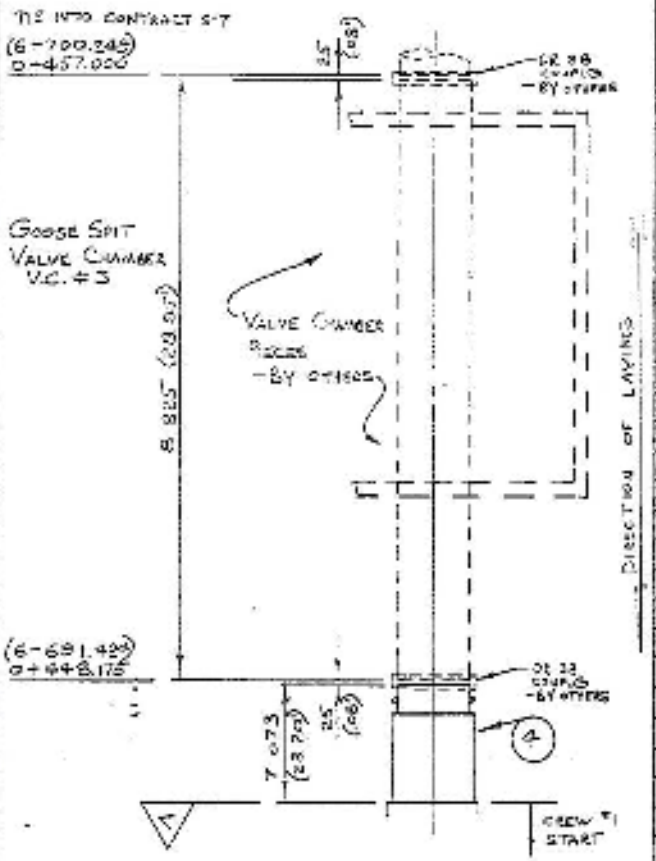
NOTES

1. ALL DIMS. ARE IN S.I. UNITS EXCEPT BRACKETED IMP. UNITS.
2. TYPE V CEMENT COATING & LINING (0.65" EXTRA COATING)
3. MAX. JOINT DEFLN = 1°-03' PER JOINT.
4. F.W. — FLEXIBLE FIELD WELDED JOINT 6 (.02) REF. 46-A-6-D-125.
5. COAL TAR ENAMEL COATING & CEMENT MORTAR LINING TO BE FIELD APPLIED ON PSE.

LEGEND

- ACCESS HATCH
- BLOW DOWN
- VALVE CHAMBER
- CLOSURE

CANRON INC. PIPE DIVISION	COMOX–STRATHCONA S-S COURTENAY/GOOSE SPIT FORCEMAIN	Pw: 500 kPa (73 psi) Pw+s: 750 kPa (109 psi) Ps: 750 kPa (109 psi)	Scale: NTS	Date: JUNE 15 1982		
			Drawn by: DAB	Checked by: GWL	Approved by:	Drawing No. 81-0110-1 / Rev. A



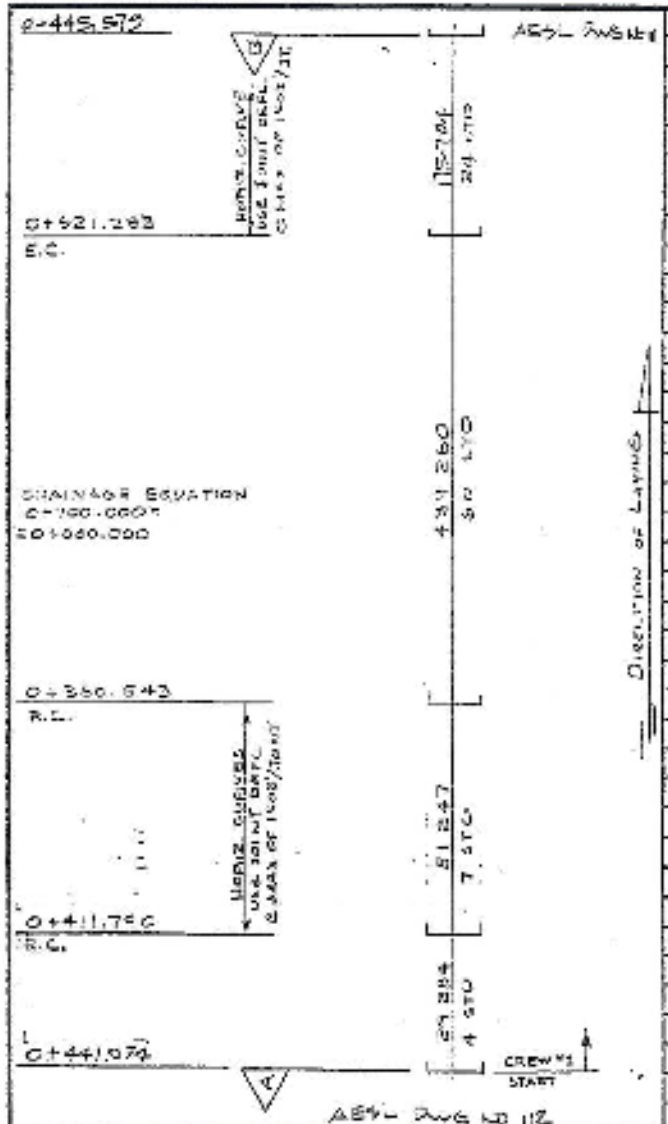
VK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CLASS TYPE	SHOE	REF. DWG. NO.	REVISIONS
									⑤ DELETED VALVE CHAMBER FITTINGS MK 1, 2, 3
4	1	820 (32¼)	SHORT ¾w PSE TO SUIT Ø2.38 COUPLED ¾w c TIE LUGS (34½ x ⅜) O.D. PSE.	7.067 (23'-2⅛")	C-303	100	PSE/PE	91-0110-29	

SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

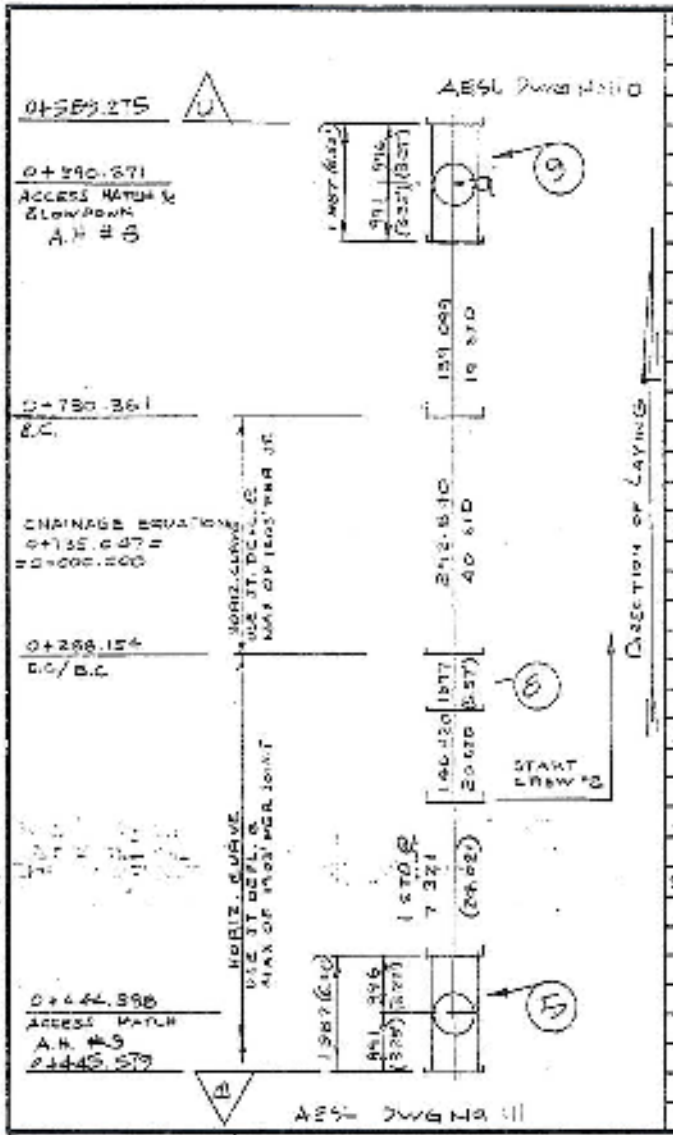
COMOX – STRATHCONA S5
COURTENAY / GOOSE SPIT FORCEMAIN

Pw: 500 kPa (73 psi)	Scale: N.T.S.	Date: JUNE 10 1992	
Pmax: 750 kPa (109 psi)	Drawn by: JAB	Checked by: AWL	Approved by:	Drawing No. 91-0110-2	Rev. 6
Pt: 750 kPa (109 psi)			



MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	TYPE	ENDS	REF. DWG. NO.	REVISIONS
STD	34		STD PIPE	7315 (24'-0")		100	S/B		
									B.C. WAS 0+622.002
STD	90	820 (32¼)	STD PIPE	7315 (24'-0")	C-303	00	S/B		
									A) GENERAL REVISION
									B.C. WAS 0+360.643
STD	7		STD PIPE	7315		100	S/B		
									E.C. WAS 0+410.014
STD	4		STD PIPE	7315 (24'-0")		100	S/B		
									SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION	Comox Strathcona S.S. Courtenay/Goose Spit Force Main	Pw: 500 kPa (73 psi)	Scale: N.T.S.	Date: JUNE 10 1982			
		Pwes: 750 kPa (109 psi)	Drawn by: DAB	Checked by: QM	Approved by:	Drawing No. 91-0110-3	Rev. A
		Pt: 750 kPa (109 psi)					

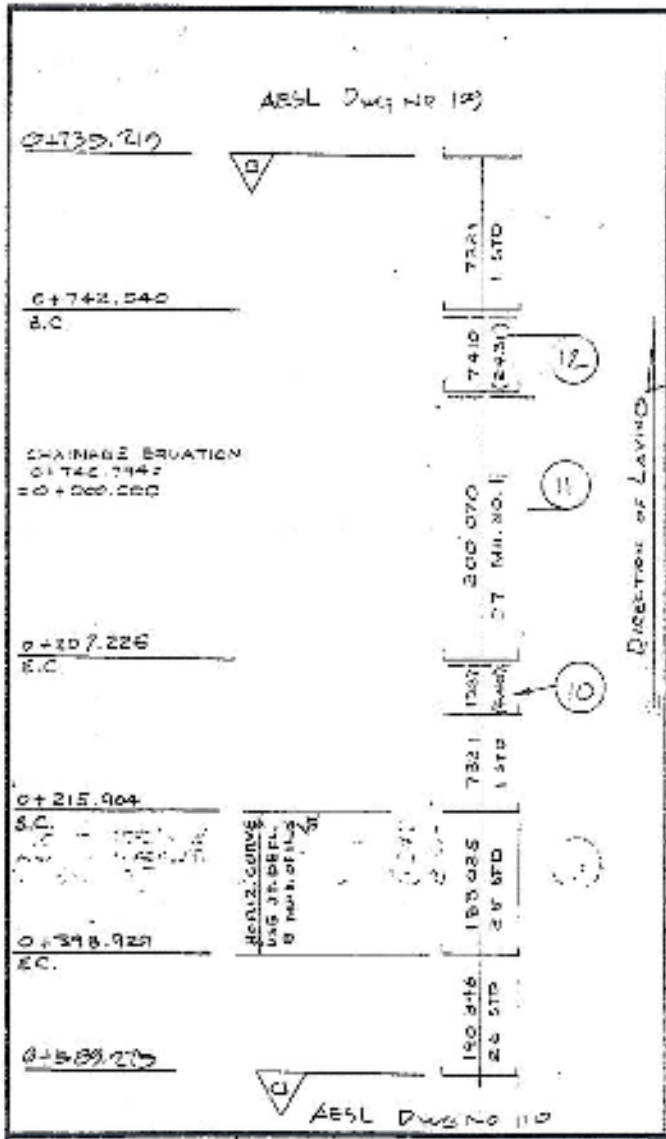


MK. NO.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL.	ENDS	REF. DWG. NO.	REVISIONS
9	1	900/600	TEE 90° (20") RED'D OUTLET 90°	1.981	C-303	B	5/8/RG	91-0110-33	WAS 0+891.914
			90° (8") RED'D	(6'-5")					
			OUTLET 60 PT. TANG.						
STD	19	820	STD PIPE	7.315	C-303	100	S/B		
				(24'-0")					
									B.C. WAS 0+787.447
STD	40	820	STD PIPE	7.315	C-303	100	S/B		
				(24'-0")					
									A) GENERAL REV.
8	1	820	SHORT PIPE	1.891	C-303	100	S/B		
				(6'-2 7/8")					
STD	20	820	STD PIPE	7.315	C-303	100	S/B		
				(24'-0")					
									(B) WAS 0+268.154
STD	1	820	STD	7.315	C-303	100	S/B		MK 8 & MK 7
				(24'-0")					
5	1	900/600	TEE 90° (20") RED'D OUTLET	1.981	C-303	B	5/8/RG	91-0110-30	WAS AT 0+445
				(6'-5")					
									SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

COMEX STRATHCONA SS
COURTENAY / GOOSE SPIT FORCEMAIN

Pw:	500 kPa (73 psi)	Scale: N.T.S.		Date: JUNE 10 1982		
Pw-s:	750 kPa (109 psi)	Drawn by: DAS	Checked by: JHH	Approved by:	Drawing No. 91-0110-4	Rev. B
Pt:	750 kPa (109 psi)					



MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CLASS	ENDS	REF. DWG. NO.	REVISIONS
STD	1	820	STD PIPE	7315 (24'0")	C-303	100	S/B		
12	1	820	NSTD c/w 1°00 BEVEL BELL	7404 (24'3½")	C-303	100	S/B	91-0110-34	B.C. WAS 0+742.794
11	27	820	NSTD 9/11 2° BEV BELL	7404 (24'3½")	C-303	100	S/B	91-0110-34	
10	1	820	SHORT 9/11 1° BEV BELL	1351 (4'5⅛")	C-303	100	S/B	91-0110-34	AS GEN. REVISION
STD	1	820	STD PIPE	7315 (24'0")	C-303	100	S/B		
STD	2.5	820	STD PIPE	7315 (24'0")	C-303	100	S/B		B.C. WAS 0+218.694
									E.C. WAS 397.923
STD	36	820	STD PIPE	7315 (24'0")	C-303	100	S/B		
									SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

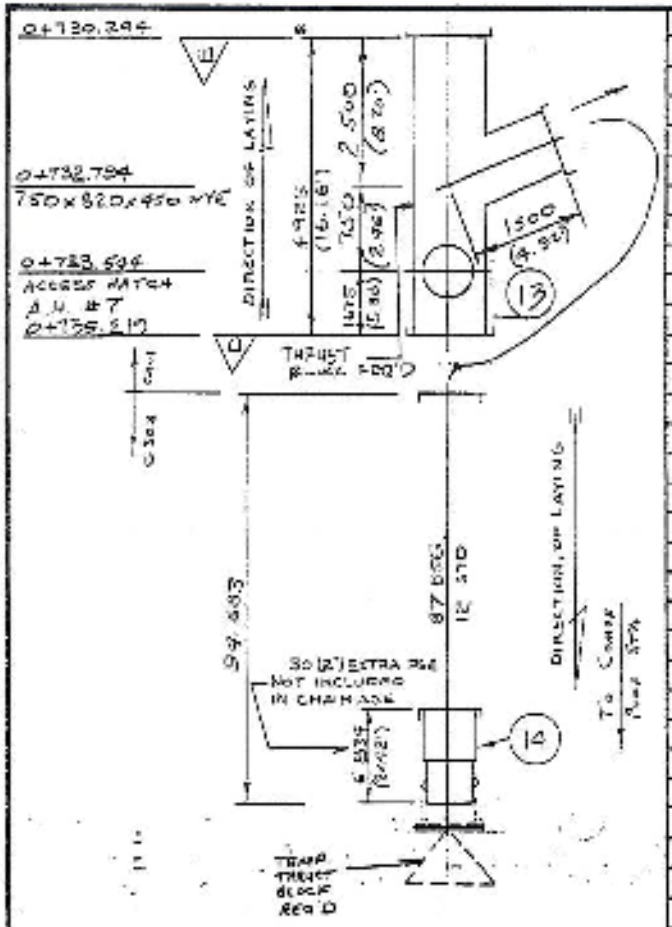
Comox Strathcona SS
Courtenay/Goose Spit Forcemain

Pw:	500 kPa	(73 psi)
Pw+a:	750 kPa	(109 psi)
Pt:	750 kPa	(109 psi)

Scale: N.T.S.

Date: June 10 1982

Drawn by:	Checked by:	Approved by:	Drawing No.	Rev.
DAB	AJH		91-0110-5	A



MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CLASS	ENDS	REF. DWG. NO.	REVISIONS
13	1	750 (30")	WYE c/w (8") BR. @ 73°00'-56" W.L.	4.918	C-301	8	S/B/B	91-0110-55	DIC 77 WAS
			(20") PLG'D OUTLET	(16'-1⅝")					REPLACED WITH
									B/S
			c/w 820/750 CONCENTRIC						B/WYE WAS 72°
			INTERNAL RODDER SEE LONG						
			(TOP FLAT)						
									A) GENERAL REVISION
STD	12	450 (18")	STD	7.315 (24'-0")	C-303	100	S/B		B) WAS 14 STD
14	1	450	SHORT PIPE P/W 16" LONG	5.834	C-303	100	S/B/S	91-0110-36	C) WAS 14 WAS (11'-8")
		457	BY 457 I.D. P&F TO	(19'-5")					D) WAS 14 WAS 4 THICK
			SUIT COUPLING C/W 2 TIE						
			LUGS.						
			(9/16") WALL ON PSE						
									SEE APPLICABLE NOTES
									P/U DWG. NO. 91-0110-1

CANNON INC. PIPE DIVISION

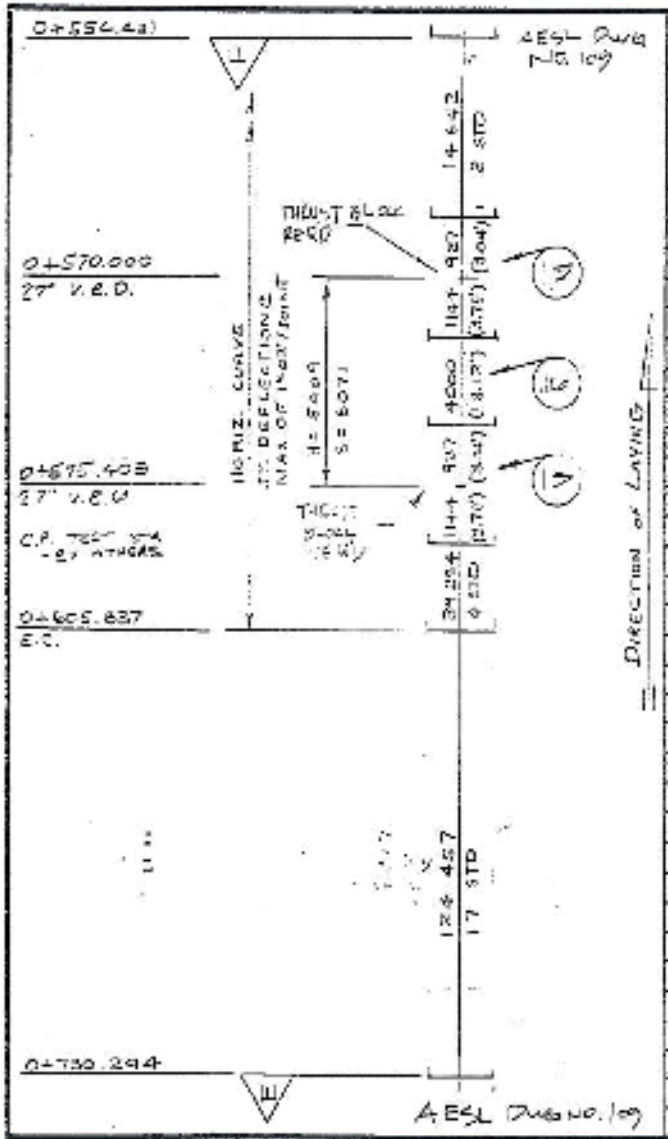
Convex Strathcona 55
Courtenay / Goose Spit Forcemain

Pwi	500 kPa	(73 psi)
Pw+si	780 kPa	(109 psi)
Pt	750 kPa	(109 psi)

Scale: N.T.S.

Date: JUNE 10 1982

Drawn by:	Checked by:	Approved by:	Drawing No.	Rev.
DAB	GAE.		91-0110-6	C



MK. No	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. (TYP.)	ENDS	REF. DWG. NO.	REVISIONS
-									
STD	2	750	STD PIPE	7315	C-301-L	10	S/B		
15	1	750	27° ELBOW	—	C-301-L	8	S/B	91-010-37	
16	1	750	SHORT	3994 (13'-1⅛")	C-301-L	10	S/B		A) GENERAL REVISION
17	1	750	27° ELBOW	—	C-301-L	8	S/B	91-010-37	
STD	4	750	STD PIPE	7315 (24'-0")	C-301-L	10	S/B		E.C. WAS 0+605.886
STD	17	750	STD PIPE	7315 (24'-0")	C-301-L	10	S/B		

SEE APPLICABLE NOTES ON DWG. NO. 91-010-1

CANRON INC. PIPE DIVISION

COMOX STRATHCONA SS
COURTENAY / GOOSE SPIT FORCEMAIN

Pw:	560 kPa	(73 psi)	
Pwss:	750 kPa	(109 psi)	
Pt:	750 kPa	(109 psi)	

Scale: N.T.S.

Drawn by: DAB

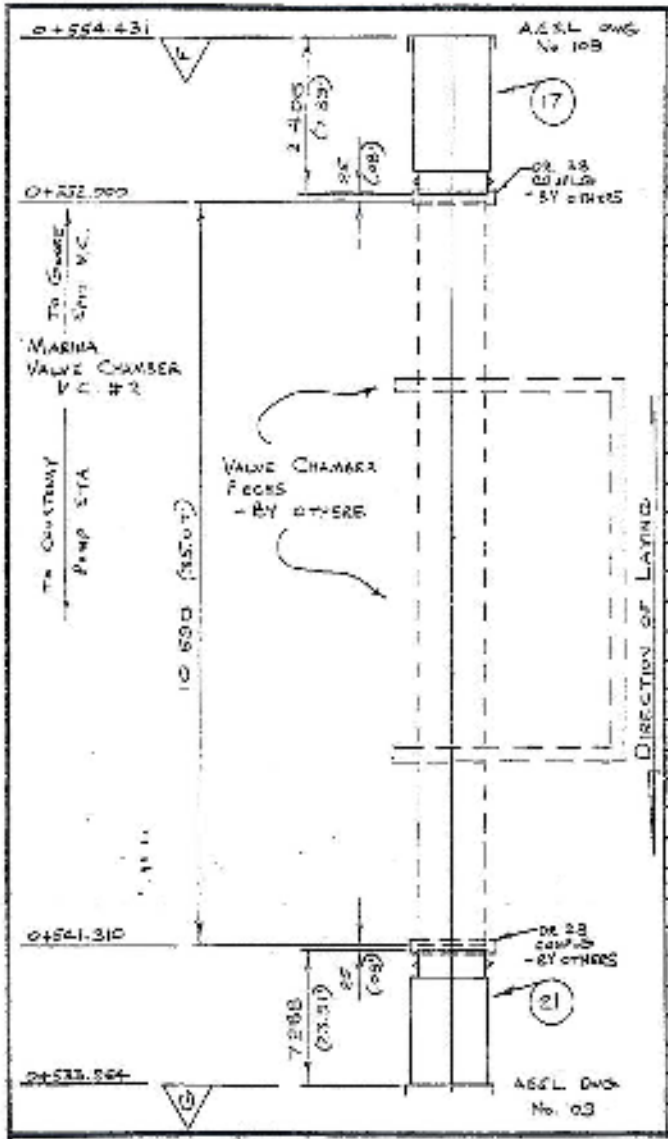
Checked by: DW.

Approved by:

Date: JUNE 19 1982

Drawing No. 91-0110-T1

Rev. A

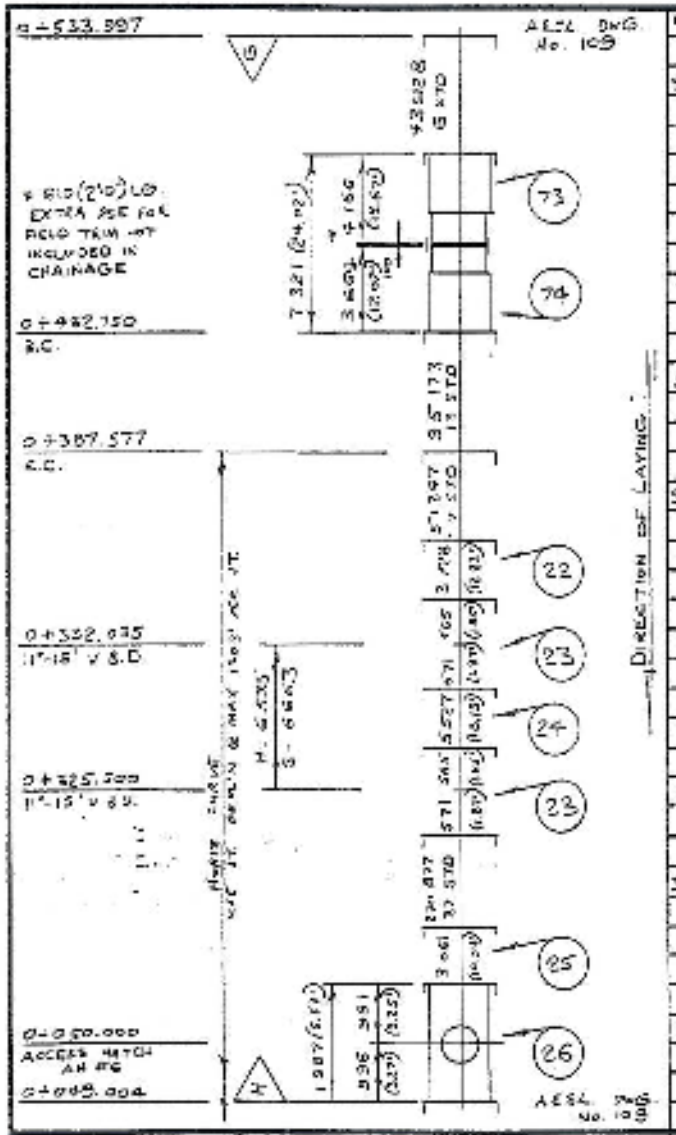


MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. (DR.)	ENDS	REF. DWG. NO.	REVISIONS
17	1	750	SHORT ¼ PSE To SHT pt. 38	2.40 G	C301-L	10	P/PSE	9-0110-38	(B) WAS 2 TIE LUGS
		(30")	COUPLG. ¼ + TIE LUGS	(7'-10⅝")					(D) NIPPLE WAS (3½") L
			(31¼" x ¼") O.D. PSE						
									(E) DELETED VALVE CHAMBER FITTINGS MK 18, 19, 20.
2	1	750	SHORT ¼ PSE To SHT	7.282	C301-L	10	PSE/P	91-0110-42	(B) WAS 2 TIE LUGS
			COUPLG (DR. 38) ¼ + TIE	(23'-0⅝")					(D) NIPPLE WAS (3½") L
			LUGS (31¼" x ¼") O.D. PSE						
									SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA S-5
COURTENAY / GOOSE SPIT FORCEMAIN

Pw:	500 kPa (73 psi)	Scale: N.T.S.	Date: JUNE 10 1982
Pw+s:	750 kPa (109 psi)	Drawn by: DAB	Checked by: [illegible]
Ps:	750 kPa (109 psi)	Approved by: [illegible]	Drawing No. 91-0110-8
			Rev. 0

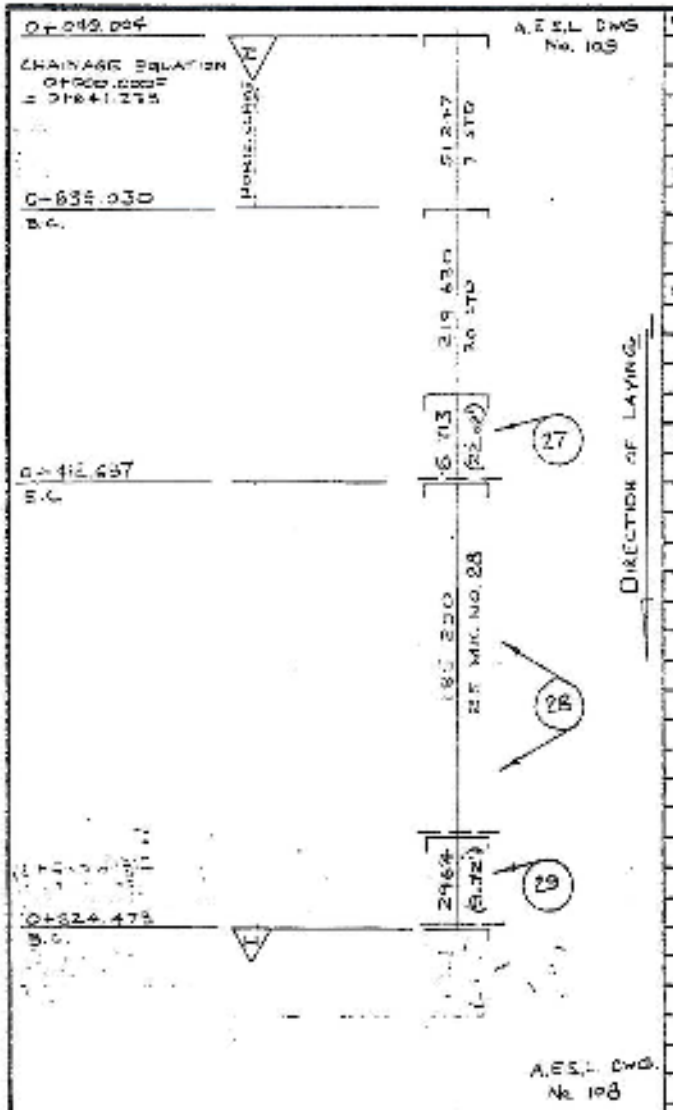


MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL.	ENDS	REF. DWG. NO.	REVISIONS
STO	6	750	STO	7315 (24'-0")	C30-L	10	S/S		(B) DELETED 1 STO
									B.C. WAS 0+482.779
73	1	750	SHORT S/W (5'-2") PSE & (1'-1") BUTT STRAP	1.166 (3'-10")		10	S/PSE	91-010-47	(B) ADDED MK 73
									(B) MK 74 (CHANGE NO.)
									(C) MK 73 HAD (1'-7") PSE
74	1	750	SHORT S/W (1'-7") PSE & (1'-1") BUTT STRAP	3.668 (12'-0")		10	PSE/S	91-010-48	
STO	13	750	STO	7315		10	S/S		
STO	7	750	STO	7315		10	S/S		
22	1	750	SHORT	3.722 (12'-24")		10	S/S		
23	1	750	11°-15' BEV. ADAPT	—		S	S/S	91-010-43	
24	1	750	SHORT	5.621 (18'-5")		10	S/S		
									(A) GENERAL REVISION
23	1	750	11°-15' BEV. ADAPT	—		S	S/S	(A) 91-010-43	
STO	37	750	STO	7315		10	S/S		
25	1	750	SHORT	3.055 (10'-0")		10	S/S		
26	1	750/600	TEE S/W (20") FLG'D OUTLET	1951 (6'-5")	T	S	S/S or FLG	91-010-44	
									SEE APPLICABLE NOTES ON DWG. NO. 91-010-1

CANRON INC. PIPE DIVISION

COWEX-STRATHCONA S-5
COURTENAY/GOOSE SPIT FORCEMAIN

Pw: 500 kPa (73 psi)	Scale: N.T.S	Date: JUNE 10 1982	
Pw+si: 750 kPa (109 psi)	Drawn by: DAB	Checked by: RAL	Approved by:	Drawing No. 91-010-9	Rev. C
Pt: 750 kPa (109 psi)			

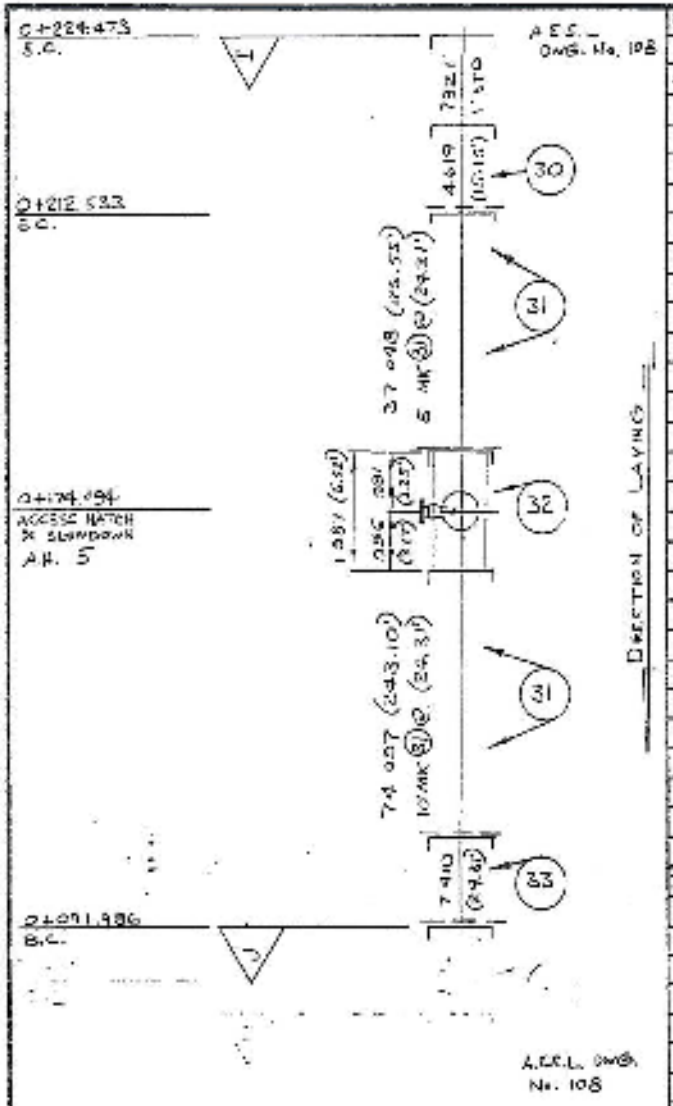


MK. NO.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. TYPE	ENDS	REF. DWG. NO.	REVISIONS
STD	7	750	STD PIPE	7315 (24'-0")	C-36M	10	S/G		B.C. WAS 0+041.275
STD	30	750	STD PIPE	7315 (24'-0")	C-36M	10	S/G		
27	1	750	SHORT 7½ 1°-30' BEV. BELL	6707 (22'-0")	C-36M	10	S/G	91-0110-45	
									A) GENERAL REVISION
28	1	750	MITRE 7½ 3°-00' BEVEL BELL	7404 (24'-3½")	C-36M	10	S/G	91-0110-45	
29	1	750	SHORT 7½ 9°-15' BEVEL	2458 (9'-5⅞")	C-36M	10	S/G	91-0110-45	
									SEE APPLICABLE NOTES ON DWG. NO. 91-0117-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA SS
COURTENAY / GOOSE SPIT FORCEMAIN

Pw: 500 kPa (73 psi)	Scale: N.T.S.		Date: JUNE 10 1982			
Pmax: 750 kPa (109 psi)	Drawn by: DAB	Checked by: GJK	Approved by:	Drawing No. 91-0110-10	Rev. A
Pt: 750 kPa (109 psi)					



MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL.	ENDS	REF. DWG. NO.	REVISIONS
STD	1	750	STD PIPE	7.315	C-304-L	10	S/B		
				[24'-0"]					
30	1	750	SHORT P/W 11.25° BEV BELL	4.619	C-304-L	10	S/B	91-0110-45	
				[15'-1½"]					
31	5	750	NSTD P/W 2°-00'-00" BEV BELL	7.404	C-304-L	10	S/S	91-0110-45	
				[24'-3½"]					
32	1	19mm	TSE P/W 20 PLG'D OUTLET	1.981	C-304-L	B	S/B/PLG	91-0110-46	WAS 0+172.000
			& (8") PLG'D OUTLET	[6'-6"]					
			BOTT TANG						
									A) GEN. REVISIONS
31	10	750	NSTD P/W 2°-00'-00" BEV BELL	7.404	C-304-L	10	S/S	91-0110-45	
33	1	750	NSTD P/W 1°-03'-00" BEV BELL	7.404	C-304-L	10	S/S	91-0110-45	R.C.W.A.S. 0+049.529
				[24'-3½"]					

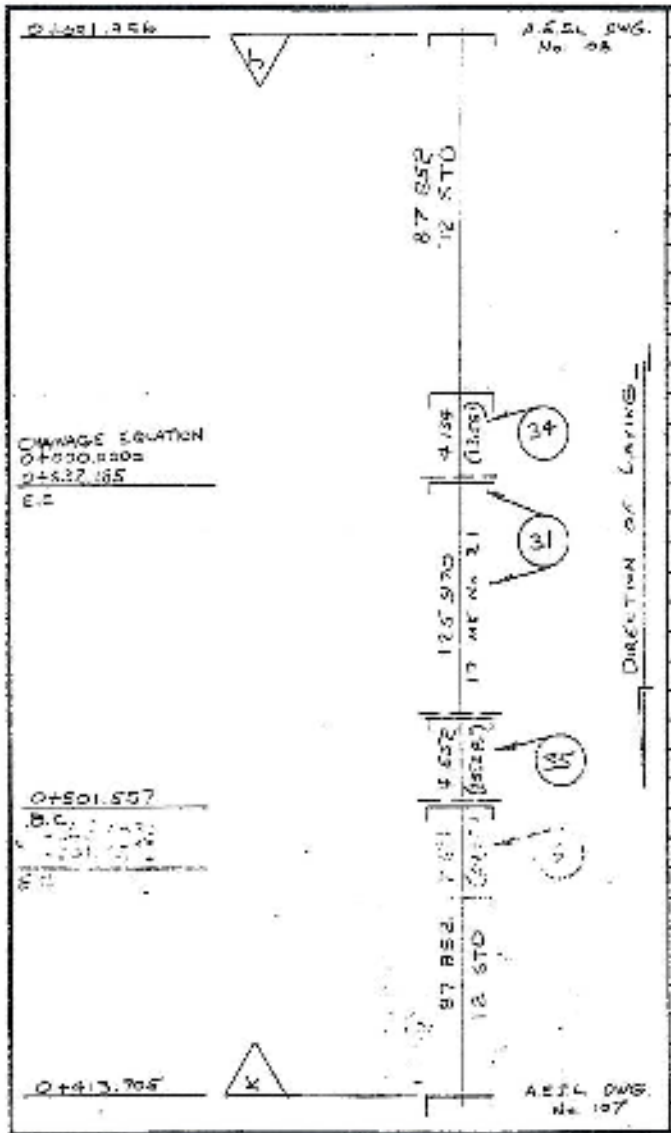
SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

COMOX-STRATHCONA SS
COURTENAY/GROSS SPIT FORCEMAIN

PW:	500 kPa	(73 psi)	
PW+S:	750 kPa	(109 psi)	
PT:	750 kPa	(109 psi)	

Scale: N.T.S.
Drawn by: DAB
Checked by: GJW
Approved by:
Date: JUNE 10 82
Drawing No. 91-0110-1
Rev. A



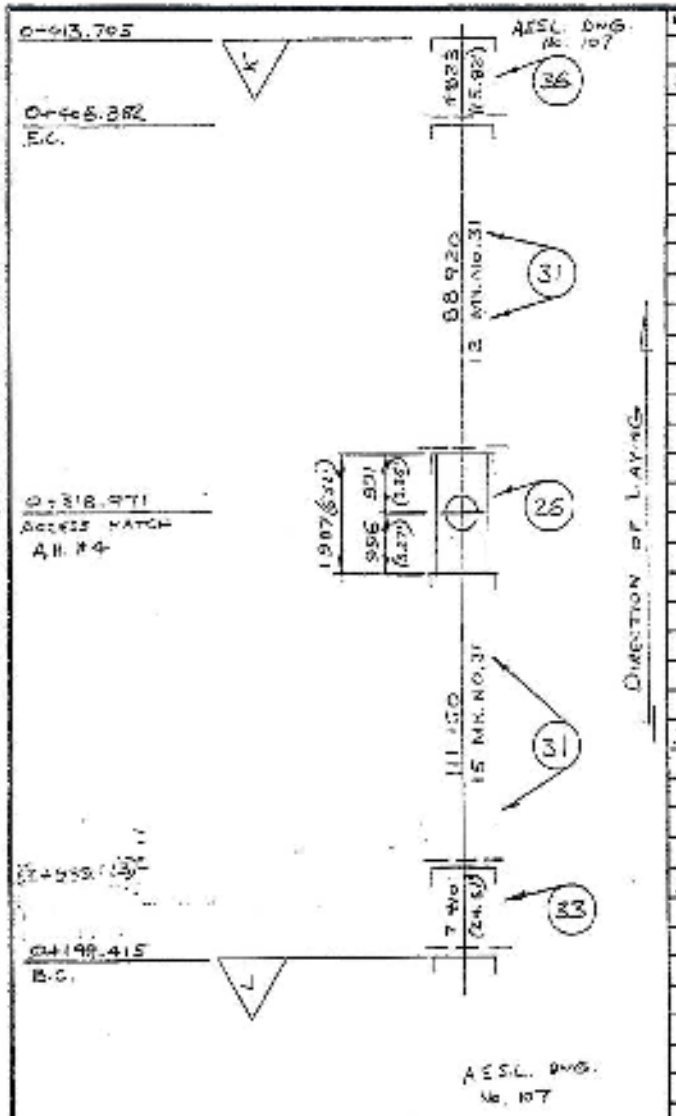
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. TYP.	ENDS	REF. DWG. NO.	REVISIONS
									(2) DELETED MK 73 & MK 74 (CLOSURE FIT)
STD	12	750	STD	7.315 (24'-0")	C-301-L	10	3/8		ADDED 1 STD
34	1	750	SHORT 4/W 1°-00'-00" BEV. BEND	4.128 (13'-6 1/2")	C-301-L	10	5/8	91-0110-49	
31	17	750	STD 4/W 2°-00'-00" BEV. BEND	7.444 (24'-3 1/2")	C-301-L	10	5/8	91-0110-45	A) GENERAL REVISION
35	1	750	SHORT 4/W 1°-00'-00" BEV. BEND	4.662 (15'-3 3/8")	C-301-L	10	5/8	91-0110-49	
2	1	750	STD [illegible]	[illegible]	C-301-L	10	5/8		[illegible]
STD	12	750	STD PIPE	7.315 (24'-0")	C-301-L	10	5/8		

SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA S5
COURTENAY/GOOSE SPIT. FORCEMAIN

Pw: 500 kPa (73 psi)	Scale: N.T.S.		Date: JUNE 10 1982
Pw+s: 750 kPa (109 psi)	Drawn by: JAB	Checked by: G.H.	Approved by:	Drawing No. 91-0110-12	Rev. 8
Pt: 750 kPa (109 psi)			

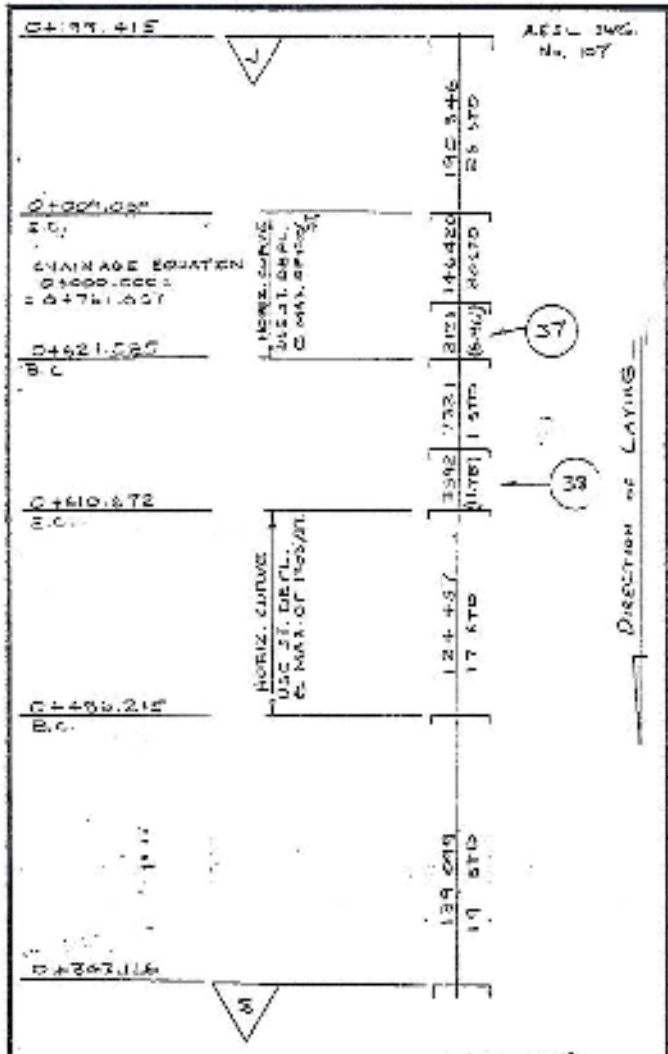


MK. NO.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL.	ENDS	REF. DWG. NO.	REVISIONS
36	1	750	STRT c/w 1°-00' BEV. BELL	48.7 (15'-11½")	C-301-L	10	S/B	91-0110-48	
31	12	750	NSTD c/w 2°-00' BEV. BELL	7.404 (24'-3½")	C-301-L	10	S/B	91-0110-45	
26	1	750 x 750	TEE c/w (20") FLG'D OUTLET	1.981 (6'-6")	C-301-L	10	S/B	91-0110-44	WAS AT 0+317.773
31	16	750	NSTD c/w 2°-00' BEV. BELL	7.404 (24'-3½")	C-301-L	10	S/B	91-0110-45	
33	1	750	NSTD c/w 1°-00' BEV. BELL	7.404 (24'-3½")	C-301-L	10	S/B	91-0110-45	B.C. WAS 0+197.773
									SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA SS
COURTENAY / GOOSE SPIT FORCEMAIN

Pw: 500 kPa (73 psi)	Scale: N.T.S.		Date: JUNE 10 1982		
Pws: 750 kPa (109 psi)	Drawn by: DAS	Checked by: GHL	Approved by:	Drawing No. 91-0110-13	Rev. A
Pt: 750 kPa (109 psi)					



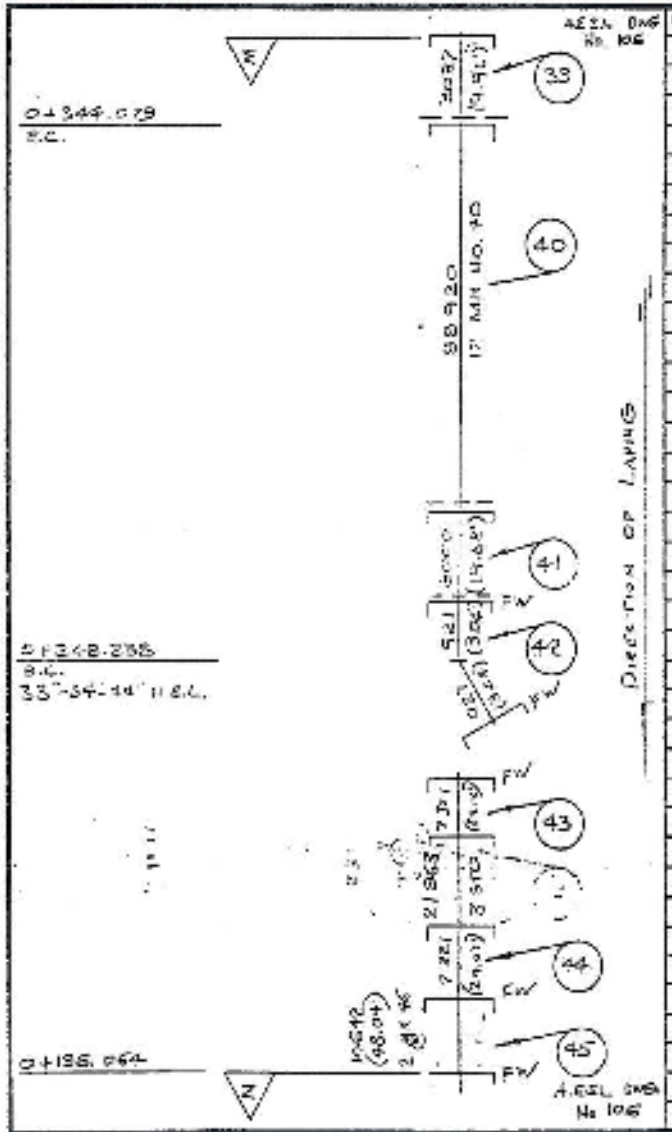
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	TYPE	ENDS	REF. DWG. NO.	REVISIONS
STD	36		STD PIPE	7315	C-SDR-L		S/E		
				(24'-0")					
		N				L			E.C. WAS 0+487.033
STD	20		STD PIPE	7315	C-SDR-L		S/E		
				(24'-0")					
37	1		SHORT PIPE	2115	C-SDR-L		S/E		
				(6'-11½")					
STD	1	750	STD PIPE	7315	C-SDR-L	10	S/E		
				(24'-0")					
38	1		SHORT PIPE	3566	C-SDR-L		S/E		
				(11'-9¾")					A) GENERAL REVISION
STD	17		STD PIPE	7315	C-SDR-L		S/E		
									E.C. WAS 0+487.746
STD	19		STD PIPE	7315	C-SDR-L		S/E		

SEE APPLICABLE NOTES ON DWG. NO. 91-010-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA SS
COURTENAY/GOOSE SPIT FORCEMAIN

Pw:	500 kPa (73 psi)	Scale: N.T.S.		Date: JUNE 10 1982			
Pw+s:	750 kPa (109 psi)	Drawn by: DAG	Checked by: GW	Approved by:	Drawing No. 91-010-14	Rev. A	
Ps:	750 kPa (109 psi)						



MK. No	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	TOP	ENDS	REF. DWG. NO.	REVISIONS
39	1	750	SHORT c/w 1°-15'-00" Bev. Bell	3.031 (9'-11⅜")		0	S/B	81-0110-49	
40	12	750	NSTD c/w 22°30'-00" Bev. Bell	7.40M (24'-3⅜")		10	S/B	81-0110-49	
41	1	750	SHORT c/w 11°15' BEVEL B	5.994 (19'-8")	C-SERIES	0	S/B FW	81-0110-49	A) & SN. REVISION
42	1	750	33°-34'-44" ELBOW c/w MR	—		8	FW S/B FW	81-0110-50	(E) DELETED "THRUST BLOCK"
43	1	750	NSTD c/w MR c/w	7.315 (24'-0")		10	FW S/B FW		
STD	3	750	STD PIPE	7.315 (24'-0")		10	FW S/B		
44	1	750	NSTD	7.315		10	S/B FW		
45	2	750	NSTD c/w MR	7.315		10	FW S/B FW		

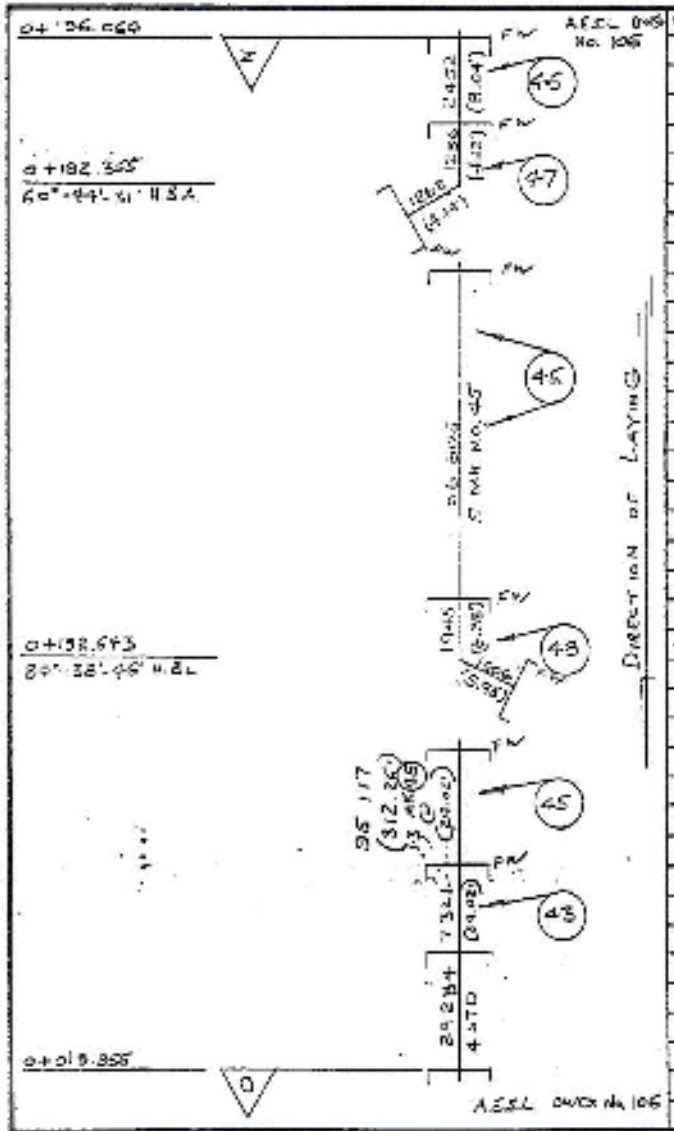
SEE APPLICABLE NOTES ON DWG. NO. 81-0110-1

CANRON INC. PIPE DIVISION

COMOX STRATHCONA S-5
COURTENAY / GOOSE SPIT FORCEMAIN

Pw: 500 kPa (73 psi)	Scale: N.T.S.	Date: JUNE 10 1982	
Pw+a: 750 kPa (109 psi)	Drawn by: DAB	Checked by: G.W.	Approved by:
Ph 750 kPa (109 psi)			

Drawing No. 81-0110-15 Rev. B

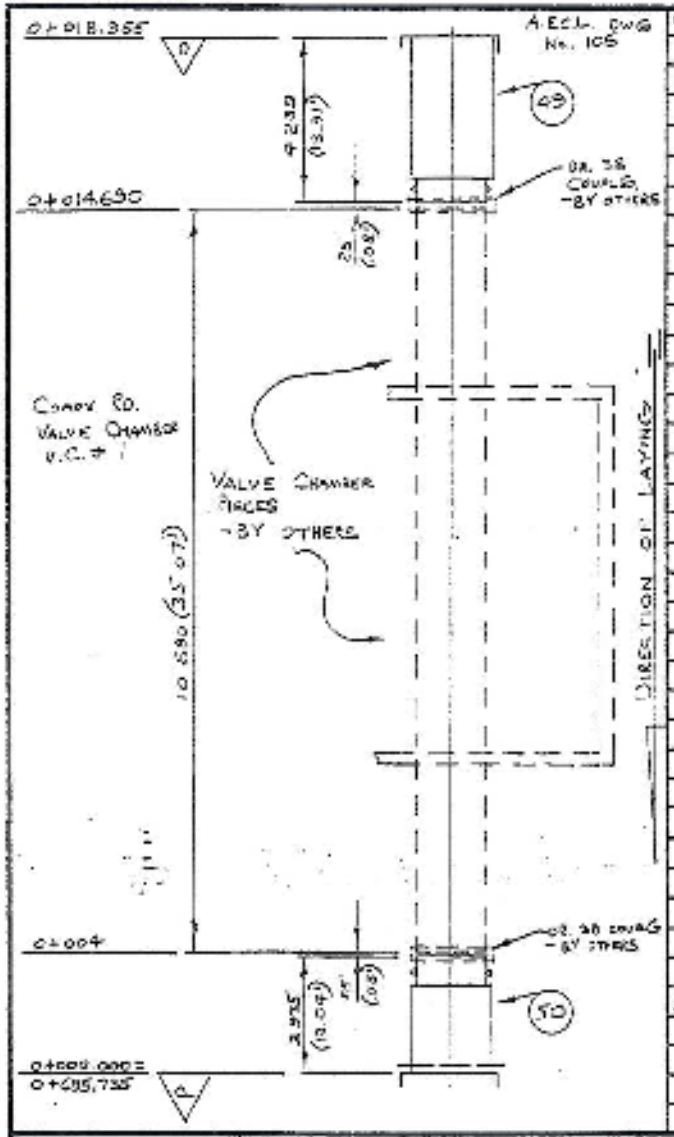


WK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	GRADE	ENDS	REF. DWG. NO.	REVISIONS
46	1	750	SPOOL	2446 (8'-0½")		10	PWS/E PW		
47	1	750	60°-44'-3" ELBOW	—			PWS/B PW	51-0110-51	(A) DELETED "THRUST BLOCK" NOTE
45	5	750	WSTD c/w WR.	7315 (24'-0")		10	PWS/B PW		
									(A) GEN. REVISIONS
48	1	750	89°-38'-46" ELBOW	—		5	PWS/B PW	51-0110-52	
45	13	750	WSTD c/w WR.	7315		10	PWS/E PW		
43	1	750	WSTD c/w WR.	7315 (24'-0")		10	PWS/B		
STD	4	750	STD PIPE	7315		10	E/B		
									SEE APPLICABLE NOTES ON DWG. NO. 51-0110-1

CANRON INC. PIPE DIVISION

Comox-Strathcona SS
Courtenay/Goose Spit Forcemain

Pw: 500 kPa (73 psi)	Scale: N.T.S.	Date: JUNE 10 1982	
Pws: 750 kPa (109 psi)	Drawn by: DAE	Checked by: GN.	Approved by:	Drawing No. 51-0110-16	Rev. B
Pt: 780 kPa (109 psi)					



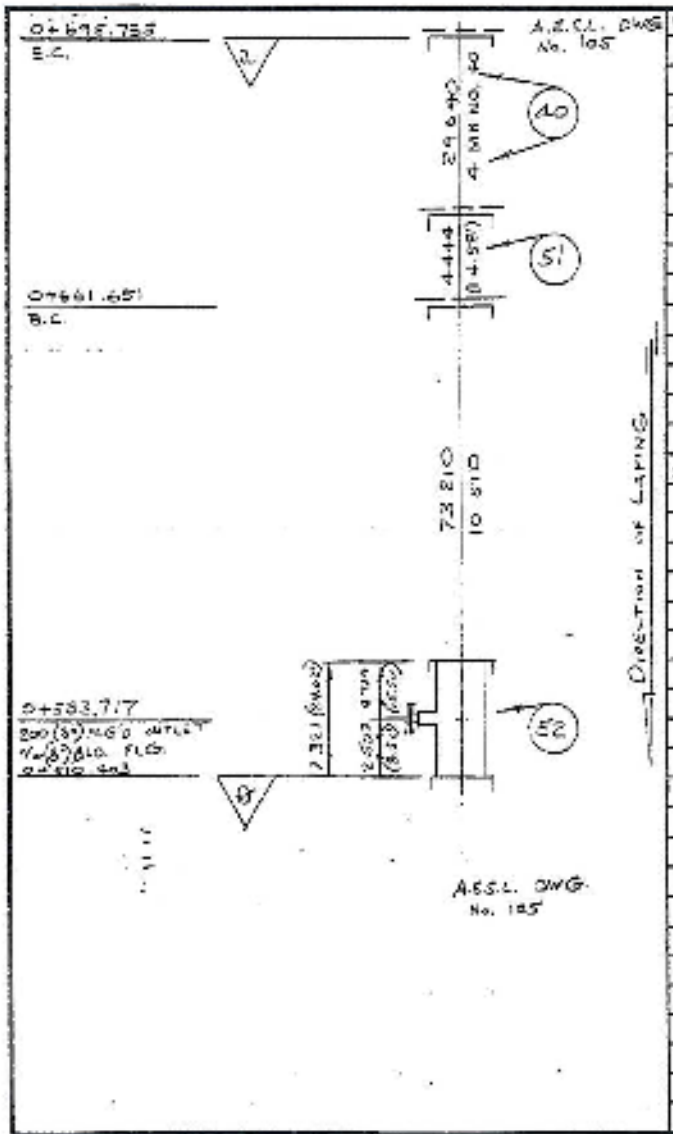
MK. No	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	FNGR	REF. DWG. NO.	REVISIONS
49	1	750	SHORT ¼w PSS TO SUIT DR 38 COUPLG ¼w 4 TIE LUGS (3¼" x ½") O.D. PSE	4.233 (13-10⅝")	CSA-L	10	S/PSE	91-010-53	(a) WAS 2 TIE LUGS (b) NIPPLE WAS (3½" O.D.) (c) DELETED VALVE CHAMBER FITTINGS M.K. 18, 19, 20
50	1	750	SHORT ¼w PSE TO SUIT DR 38 ¼w 1°-15' BEVEL SELL ¼w 4 LUGS (3¼" x ½") O.D. PSE	3.962 (13-0⅛")	CSA-L	10	PSE/S	91-010-54	(a) WAS 2 TIE LUGS (b) NIPPLE WAS (3⅝" O.D.)

SEE APPLICABLE NOTES ON DWG. NO. 91-010-01

CANRON INC. PIPE DIVISION

COMOX-STRATHCONA SS
COURTENAY / GOOSE SPIT FORCEMAIN

Pw: 500 kPa (73 psi)	Scale: N.T.S.	Date: JUNE, 0 1982	
Pw+s: 750 kPa (109 psi)	Drawn by: DAB	Checked by:	Approved by:
Pt: 750 kPa (109 psi)			Drawing No. 91-010-17 / Rev. D

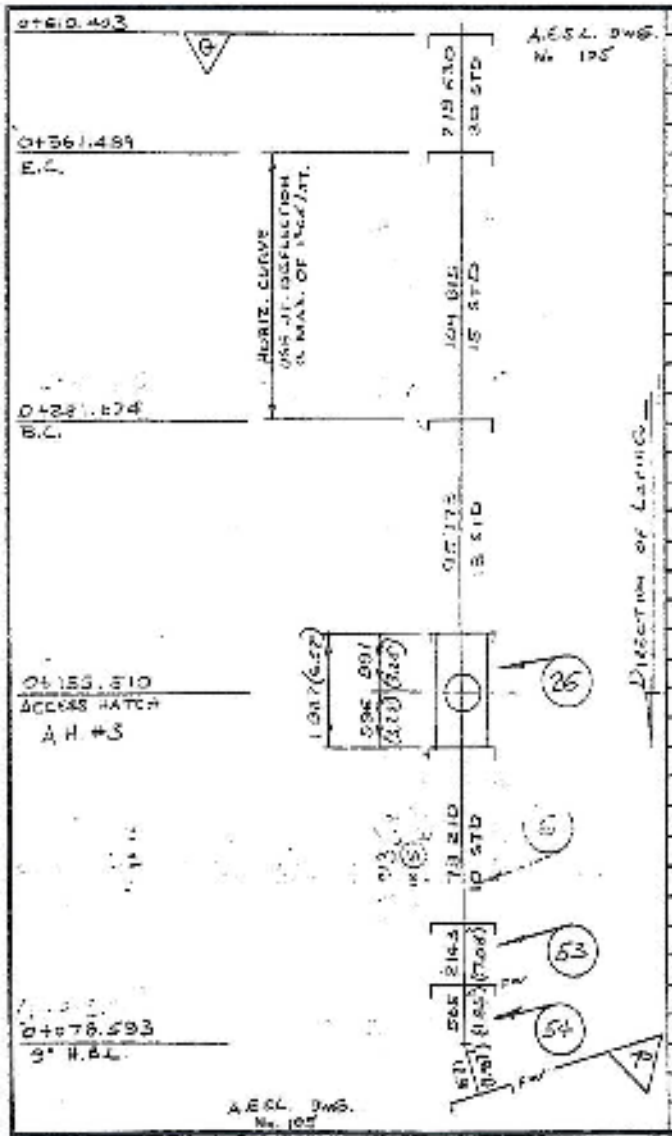


MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. TYPE	ENDS	REF. DWG. NO.	REVISIONS
40	4	750	NSTD c/w 27-30' Std Bell	7.409 (24.32')		10	5/8	91-0110-49	
51	1	750	SHORT c/w 14'-5" Std Bell	4.438 (14'-6")		10	5/8	91-0110-55	
STD	10	750	STEEL PIPE	73.15	C/SOLL	10	5/8		(B) WAS 6 m (D)
									(A) GENERAL REVISION
52	1	750	NSTD c/w (8") N.S.D OUTLET c/w (8") BLD. FLG.			10	5/8	91-0112-56	(C) CHAINAGE WAS 0+513.000
									SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANNON INC.
PIPE DIVISION

Comox Strathcona S.S.
Courtenay / Goose Spit Forcemain

Pw:	500 kPa (73 psi)	Scale: N.T.S.	Date: JUNE 10 1982		
Pwss:	750 kPa (109 psi)	Drawn by: DAS	Checked by: G.N.	Approved by:	Drawing No. 91-0110-18
Pt:	750 kPa (109 psi)				Rev. B



MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. TYP.	ENDS	REF. DWG. NO.	REVISIONS
STD	30	750	STD PIPE	7315		10	S/B		(B) WAS 34 STD.
									E.C. WAS 0+327.361
STD	15	750	STD PIPE	7315		10	S/B		
									B.C. WAS 0+254.139
STD	13	750	STD PIPE	7315		10	S/B		
									WAS AT 0+155
26	1	1350	TEE 1/L (20) RGD outlet	1981 (6'-6")	SMLL	B	5/8 MS	31-0110-44	
									A) GENERAL REVISION
STD	10	750	STD PIPE	7315 (24'-0")		10	S/B		
53	1	750	SHORT	2137 (7'-0 1/8")		10	S/B TW		
54	1	750	9° BEVEL ADAPTOR S/L HR	—		B	TS/B TW	31-0110-57	(B) DELETED THRUST BLOCK NOTE
									SEE APPLICABLE NOTES ON DWG. NO. 31-0110-1

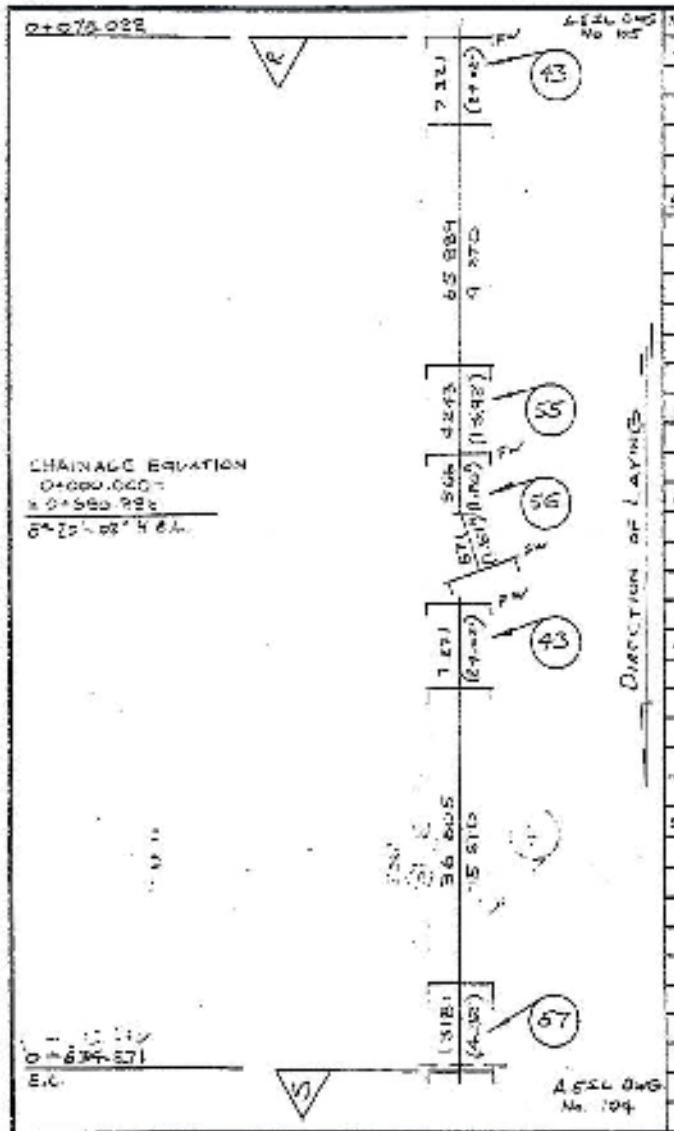
CANRON INC. PSG DIVISION

COMOX STRATHCONA SS
COURTENAY/GOOSE SPIT FORCEMAIN

Pw:	500 kPa	(73 psi)	
Pwest:	750 kPa	(109 psi)	
Pt:	750 kPa	(109 psi)	

Scale: N.T.S. | Date: JUNE 10 1982

Drawn by:	Checked by:	Approved by:	Drawing No.	Rev.
DAB	GB		31-0110-19	B

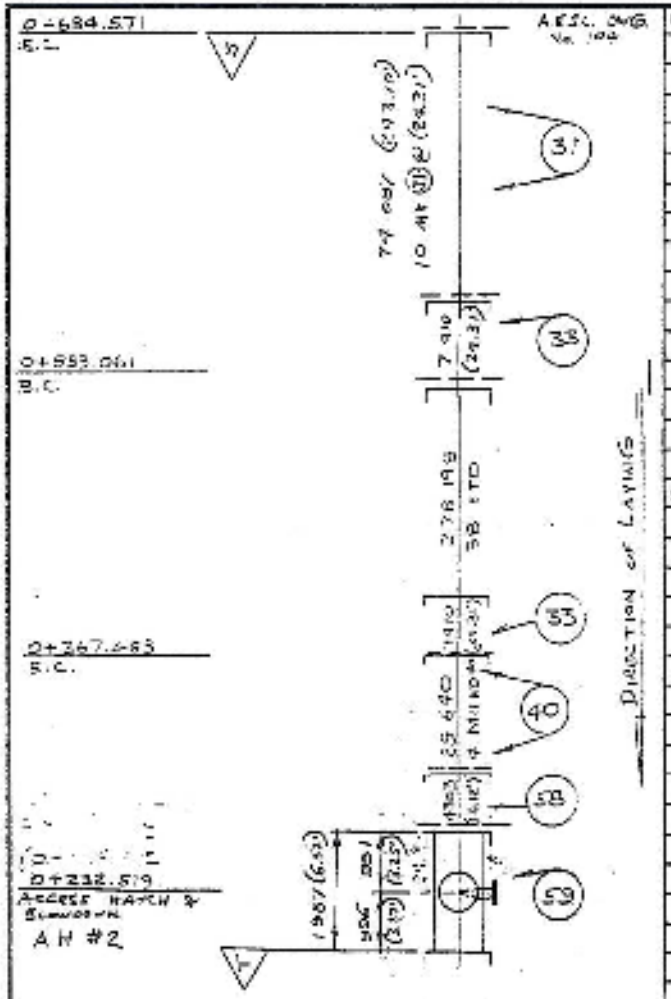


VK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL.	ENDS	REF. DWG. NO.	REVISIONS
43	1	750	NSTD 5/8 WR.	7.315 (24'-0")		10	M/S/8		
STD	9	750	STD. PIPE	7.315		10	S/8		
55	1	750	SHORT "	4.237 (13'-10")		10	S/8 PE		
56	1	750	5°-20'-08" BEVEL ADAPTOR 5/8 WR	—	CSA-L	6	S/8 PE	81-010-58	(2) REL. TO TABLE OF BEVEL NOTE
									A) GENERAL REVISION
43	1	750	NSTD 5/8 WR	7.315 (24'-0")		10	M/S/8		
STD	5	750	STD. PIPE	7.315		10	S/8		
57	1	750	SHORT 5/8 W 1° BEV. BELL	13.125 (43'-0")		10	S/8	81-010-55	
									SEE APPLICABLE NOTES ON DWG. NO. 81-010-1

CANRON INC. PIPE DIVISION

Comox Strathcona 55
Courtenay/Goose Spit Forcemain

Pw: 500 kPa (73 psi)	Scale: N.T.S.		Date: JUNE 10 1982		
Pwea: 750 kPa (109 psi)	Drawn by: DAS	Checked by: DHJ	Approved by:	Drawing No. 81-010-28	Rev. B
Pt: 750 kPa (109 psi)					



MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. TYPE	ENDS	REF. DWG. NO.	REVISIONS
31	10	750	NSTD S/W 2° BEVEL BELL	7.40m (24'-3½")	—	10	S/B	91-0110-45	
33	1	750	NSTD S/W 1° BEV BELL	7.40m (24'-3½")		10	S/B	91-0110-45	E.C. WAS 0+552.982
STD	38	750	STD PIPE	7.31m (24'-0")	03W.L	10	S/B		
									AI GENERAL REV.
33	1	750	NSTD PIPE S/W 1½° BEV. BELL	7.40m (24'-6½")		10	S/B	91-0110-45	
									E.C. WAS 0+367.665
40	4	750	NSTD PIPE S/W 2½° B. BEV.	7.40m (24'-3½")		10	S/B	91-0110-49	
58	1	750	SPORT S/L 2°00' BEV BELL	4.29m (14'-1½")		10	S/B	91-0110-55	
59	1	750/600	TEE S/L (10") 0.6 D OUTLET (8") 0.6 D OUTLET BOT TANG	1.98m (6'-6")		10	S/B/PS	91-0110-59	

SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

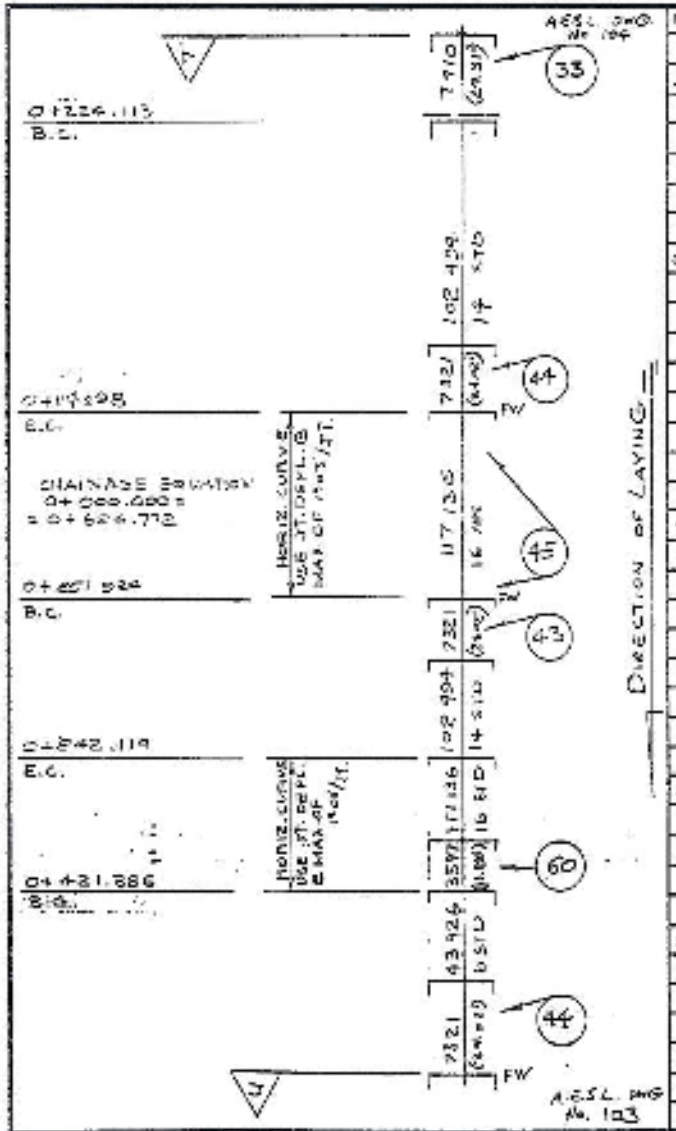
COMOX STRATHCONA SS
COURTENAY/GOOSE SPIT FORCEMAIN

Pw:	500 kPa	(73 psi)	
Pw+si:	750 kPa	(109 psi)	
Pt:	750 kPa	(109 psi)	

Scale: N.T.S.

Date: JUNE 10 1982

Drawn by:	Checked by:	Approved by:	Drawing No.	Rev.
DAB	[illegible]	[illegible]	91-0110-21	A

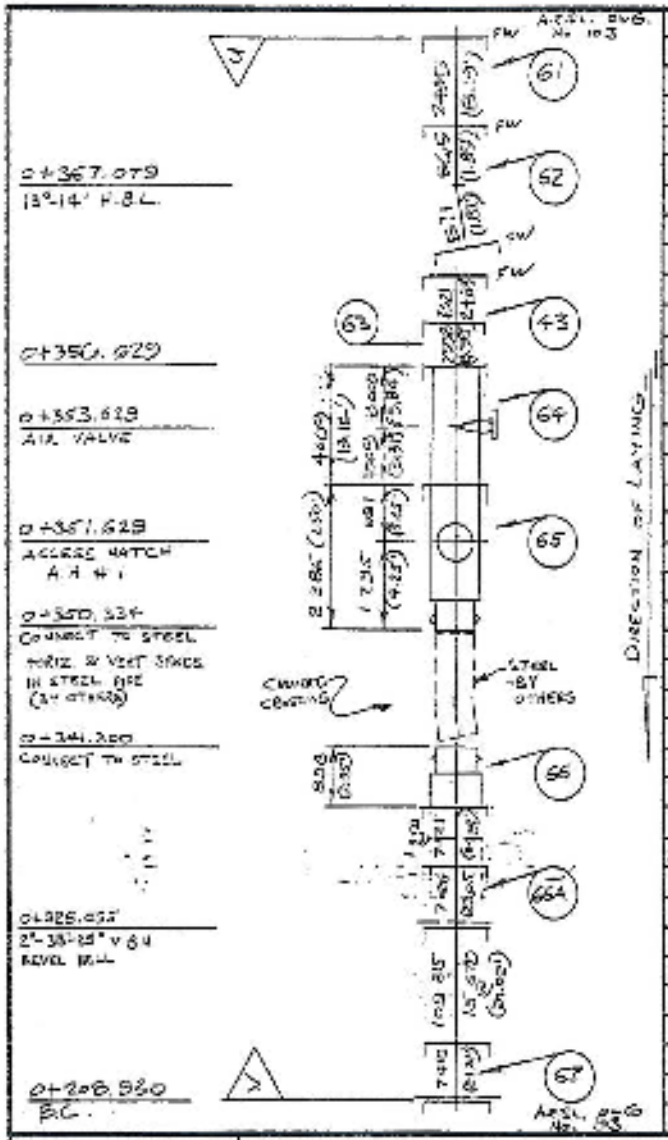


MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	FIN.	ENDS	REF. DWG. NO.	REVISIONS
33	1	750	NSTD c/w 1° BEV BELL CP	7 4of+ (24'-3")		10	S/B	91-010-45	
									B.C. WAS 0+224.113
STD	14		STD PIPE	7315		10	S/B		
44	1		NSTD	7315		10	S/B FW		E.C. WAS 0+191.298
									(B) ADDED FW JOINTS
45	16	750	NSTD c/w WEDGE RING	7315 (24'-0")	C-2-4	10	FW S/B FW		
									B.C. WAS 0+201.524
43	1		NSTD c/w WEDGE RING	7315		10	FW S/B		
									A) GEN. REVISIONS
STD	14		STD PIPE	7315		10	S/B		
									E.C. WAS 0+242.119
STD	16		STD PIPE	7315		10	S/B		
60	1		SHORT	3591 (11'-9⅜")		10	S/B		
STD	6		STD PIPE	7315		10	S/B		
44	1	750	NSTD	7315		10	S/B FW		
									SEE APPLICABLE NOTES ON DWG. NO. 31-010-1

CANRON INC. PIPE DIVISION

COMOX STRATHCONA SS
COURTENAY/GOOSE SPIT FORCEMAIN

Pw: 500 kPa (73 psi)	Scale: N.T.S.		Date: JUNE 10 1982		
Pw+s: 750 kPa (109 psi)	Drawn by: DAB	Checked by: G.N.	Approved by:	Drawing No. 81-010-22	Rev. B
Pt: 750 kPa (109 psi)					

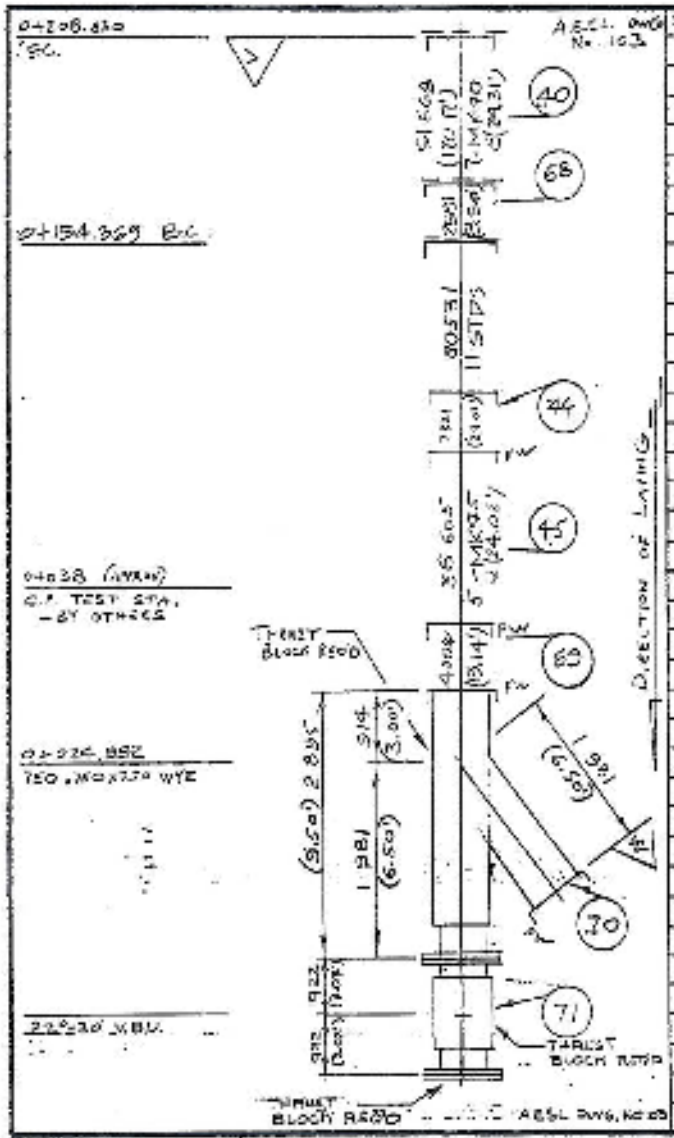


MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CLASS	ENDS	REF. DWG. NO.	REVISIONS
61	1	750	SHORT c/w WR	2460 (8'-1⅛")	C-301-L	10	P.E. S/B		
62	1	750	15°-14' BEVEL ADAPTOR c/w WR	—	C-301-L	8	P.E. S/B	91-0110-60	
43	1	750	NSTD c/w WR	7315	C-301-L	10	FWS/B		
63	1	750	SHORT	2552 (8'-4⅜")	C-301-L	10	S/B		
64	1	750	SHORT c/w (4) A.G.S. OUTLET TAP TAING	4003 (13'-1⅝")	C-301-L	10	S/B	91-0110-61	
65	1	750 S/B	PSE 9⅛ (90°) FLG'D OUTLET c/w PSE TO SUIT O.D. STEEL c/w T.S. LUGS. PSE 762 O.D. x 7.93 WALL THICKNESS	2280 (7'-6")	C-301-L	8	P.E. S/B	91-0110-62	(A) WAS 2 T.S. LUGS
66	1	750	SHORT c/w PSE TO SUIT O.D. STEEL c/w 4 T.S. LUGS. PSE 762 O.D. x 7.93 mm WALL THICKNESS.	882 (2'-11⅝")	C-301-L	8	P.E. S/B	91-0110-63	(A) WAS 2 T.S. LUGS
STD.	1	750	STD.	7315 (24'-0")	C-301-L	10	S/B		
66A	1	750	SHORT c/w 2°-38'-25" BEVEL BELL	7280 (23'-10⅝")	C-301-L	10	S/B	91-0110-55	(B) ADDED MK 66A WAS 17 STDS
STD.	5	750	STD.	7315 (24'-0")	C-301-L	10	S/B		
67	1	750	NSTD c/w 1°-15' BEV. BELL	7404 (24'-3⅝")	C-301-L	10	S/B	91-0110-55	SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

COMOX STRATHCONA S.S.
COURTENAY/GOOSE SPIT FORCEMAIN

Pw: 505 kPa (73 psi)	Scale: N.T.S.	Date: JUNE 10 1982	
Pwest: 756 kPa (109 psi)	Drawn by: DAG	Checked by: CH.L.	Approved by:	Drawing No. 91-0110-23	Rev. B
Pt: 750 kPa (109 psi)			



MK. NO.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL.	ENDS	REF. DWG. NO.	REVISIONS
40	1	750	NSTD c/w 1°-30' BEV BELL	7404 (30'-3½")	C-304-L	10	S/B	91-0110-49	
68	1	750	SLIPOT c/w 1°-15' BEV BELL	2585 (8'-5½")	C-304-L	10	S/B	91-0110-55	
STD	11	750	NSTD	7315	C-304-L	10	S/B		
44	1	750	NSTD	7315 (24'-0")	C-304-L	10	S/B PW		
45	5	750	NSTD c/w MK.	7315	C-304-L	10	PW/S/B PW		
69	1	750	SLIPOT c/w MK.	4000 (13'-1⅜")	C-304-L	10	PW/S/B PW		
70	1	750 x 750 x 750	WYE c/w (30°) BR @ 36° c/w ME.	2855 (9'-4")	C-304-L	B	T/PLUG/BE	91-0110-64	
71	1	750	22°-30' SL SHORT c/w (2) FLGS I c/w BLD FLGS	—	C-304-L	B	PE/FLG	91-0110-65	

SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

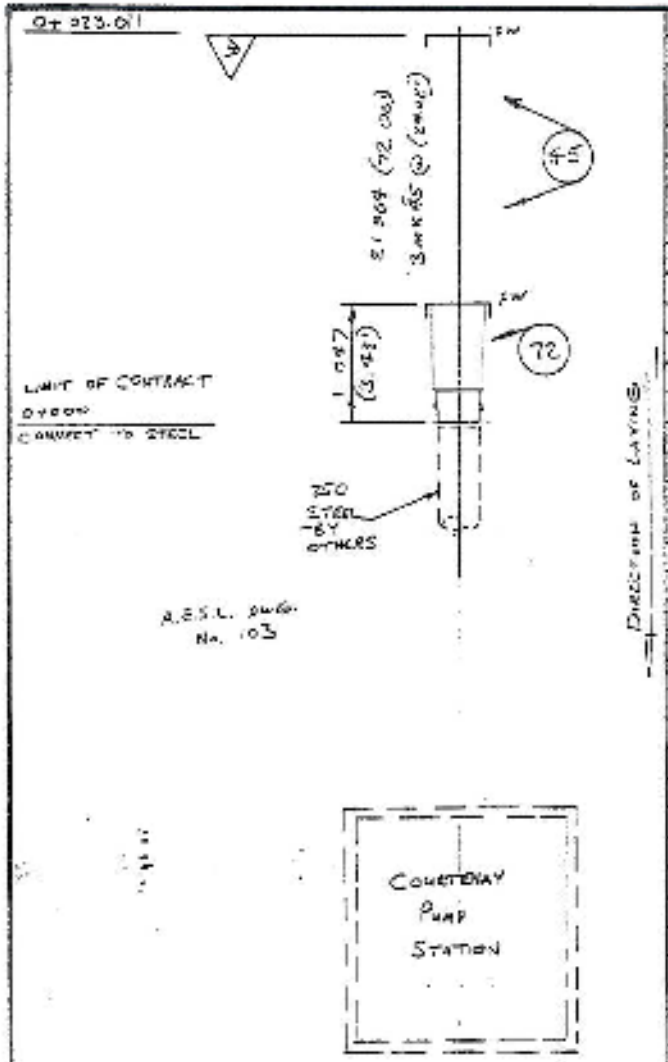
CANRON INC. PIPE DIVISION

COMOX STRATHCONA 55
COURTENAY / GOOSE SPIT FORCEMAIN

Pw:	500 kPa	(73 psi)	
Pwss:	750 kPa	(109 psi)	
Ps:	750 kPa	(109 psi)	

Scale: N.T.S. | Date: JUNE 10 1982

Drawn by:	Checked by:	Approved by:	Drawing No.	Rev.
DAB	GHJ		91-0110-24	



MK. NO.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL.	ENDS	REF. DWG. NO.	REVISIONS
45	3	750	MSTD c/w WR	7.315	C-301L	10	F/E		
									(A) GEN. REVISIONS
72	1	750	SHORT L/W PSE 762 (30") O.D PSE # 745 (5/16") THICK. TO SUIT COUPLING # 4 TIE LUGS.	1.047 (3.43')	C-301L	6	F/PSE	91-0110-63	(A) WAS 2 TIE LUGS

SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

COMOX STRATHCONA SS
COURTENAY/GOOSE SPIT FORCEMAIN

Pwi: 500 kPa (73 psi)	Scale: N.T.S.			Date: JUNE 10 1982		
Pwad: 750 kPa (109 psi)	Drawn by: DAB	Checked by: D.W.J.	Approved by:	Drawing No. 91-0110-25	Rev. 6
Pt: 750 kPa (109 psi)					

HYPRESCON

St-Eustache, September 17, 2003

Mr. Jim Eliot. c/o Graeme
Region of Comox-Strathcona
600, Comox Road
Courtenay British-Columbia
V9N 3P6

Phone: (250) 339-5231

Subject : Hyprescon Pipe
Goose Spit – Cape Lazo

Mr Eliot,

As discussed, you will find enclosed a copy of the shop drawings of the Hyprescon concrete pressure pipe that was installed in 1982.

Also included is a copy of a page taken from Canron-Hyprescon's catalogue showing the joint section of a standard bell/spigot joint. The standard thickness of the spigot ring of C303 pipes manufactured in 1982 is 4.76 mm.

Please do not hesitate to contact me if more information is needed.

Regards,

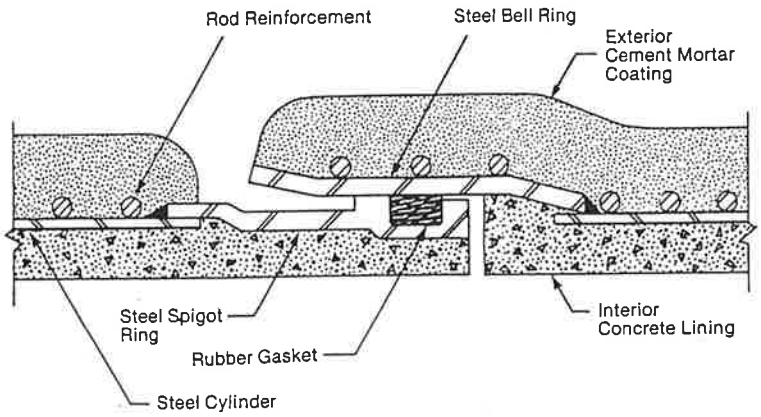
Patrick Proulx, ing.
1-800-361-4275 ext. 309

699, boul. Industriel
St-Eustache (Québec), Canada J7R 6C3
Téléphone : (450) 623-2200

5387 Bethesda Road
Stouffville (Ontario), Canada L4A 7X3
Telephone : (905) 640-5151

HYPRESCON PIPE

Pretensioned Concrete Cylinder Pipe - AWWA C303



Description

This pipe is manufactured according to AWWA Standard C303 "Reinforced Concrete Pressure Pipe-Steel Cylinder Type, Pretensioned, for Water and Other Liquids".

The pipe consists of a welded steel cylinder with sized steel joint rings welded to the ends and hydrostatically tested, a centrifugally placed concrete lining, circumferential reinforcing rods helically wound around the steel cylinder and a dense cement-mortar coating over the rod reinforcement and steel cylinder.

Pretensioned concrete cylinder pipe is manufactured in sizes from 350mm to 500mm diameter in nominal lengths of 7.32m. Pipe with diameters larger than 500mm can be provided on request.

Design

The pipe is designed according to AWWA C303 Standard, Appendix A.

The design of this pipe is based on semi-rigid pipe theory in which internal pressure and external load are designed for separately. D^2

A limiting deflection of not more than 4000 is allowed in Appendix A (D is the nominal inside diameter of the pipe, in inches). For the smaller diameters of C303 pipe supplied by Hyprescon Inc., this defection is small, generally 0.5% or less of the nominal diameter. A lesser bedding requirement than for a flexible pipe can be used.

Internal Pressure

The total steel area including rod and cylinder is determined by the classical thin wall pressure vessel formula limiting the average steel stress for design pressure conditions to 113.8 MPa or 50 percent of the specified minimum yield strength. Appendix A design provides additional capacity for transient pressures of at least 50 percent of the working pressure.

External Load

The pipe is evaluated to assure it will support the static and live loads of the specified installation conditions. The allowable load on pretensioned pipe is limited by the horizontal deflection as determined by Spangler's equation and the soil-pipe interaction that the pipe can safely sustain without occurrence of excessive cracking.

Pipe Class

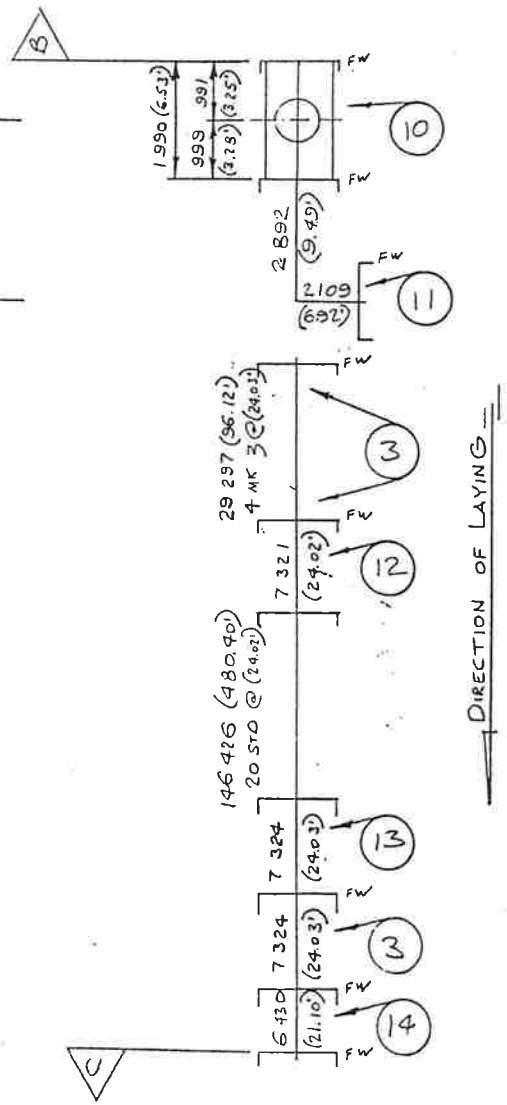
The pipe provides an additional test pressure capacity of 1.25 times the pipe class pressure.

Hydrostatic Testing

Hyprescon Inc. recommends a field test pressure for a project of 120% of the operating pressure as per AWWA Manual M9. An excessive field test pressure increases the cost of the project.

203.911

A.E.S.L. DWG. No. 107



A.E.S.L. DWG No. 108

0+152.000
ACCESS HATCH
A.H. #5

CHAINAGE EQ'N
0+155.891 =
0+000.000
90° H.B.L.

MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
10	1	900/300/x.s	TEE	1981 (6'-6")	C-301-L	B	FW/B/FLG	91-0121-25	
									(6) "THRUST BLOCK" NOTE DELETED
11	1	900	90° ELBOW c/w WR			B	FW=/BFW	91-0121-26	
3	4	900	NSTD c/w WR	7315		10	FWS/BFW		
12	1	900	NSTD c/w WR	7315		10	FWS/B		
					C-301-L				
STD	20	900	STD	7315		10	S/B		
13	1	900	NSTD	7315		10	S/BFW		
3	1	900	NSTD c/w WR	7315		10	FWS/BFW		
14	1	900	SHORT c/w WR	6421 (21'-0 7/8")		10	FWS/BFW		(8) DIMS NOW CONFIRMED

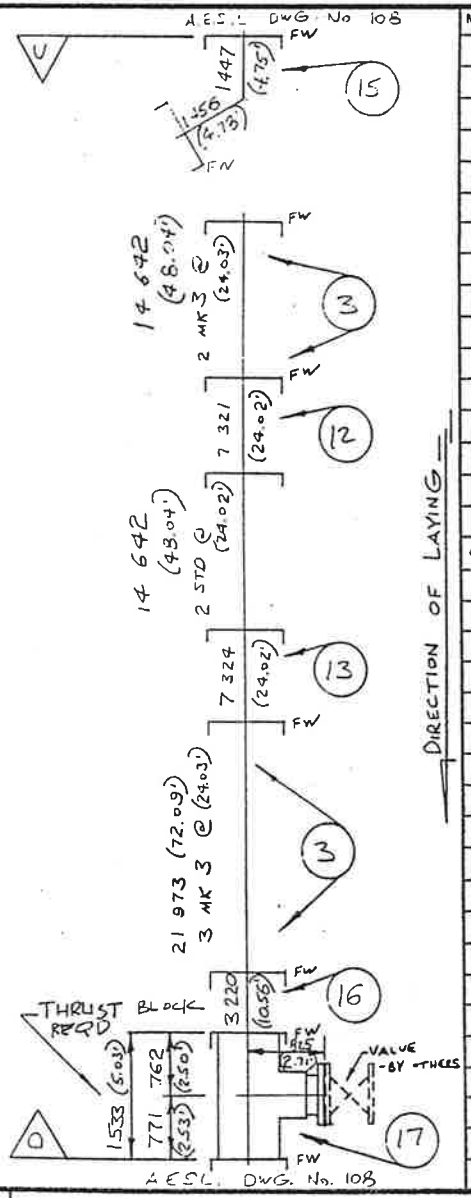
SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX-STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw:	350 kPa	(51 psi)	
Pw+s:	550 kPa	(80 psi)	
Pt:	700 kPa	(102 psi)	

Scale: N.T.S
Date: JUNE 21 1982
Drawn by: DAB
Checked by: GJN.
Approved by: GJN.
Drawing No. 91-0121-4
Rev. C



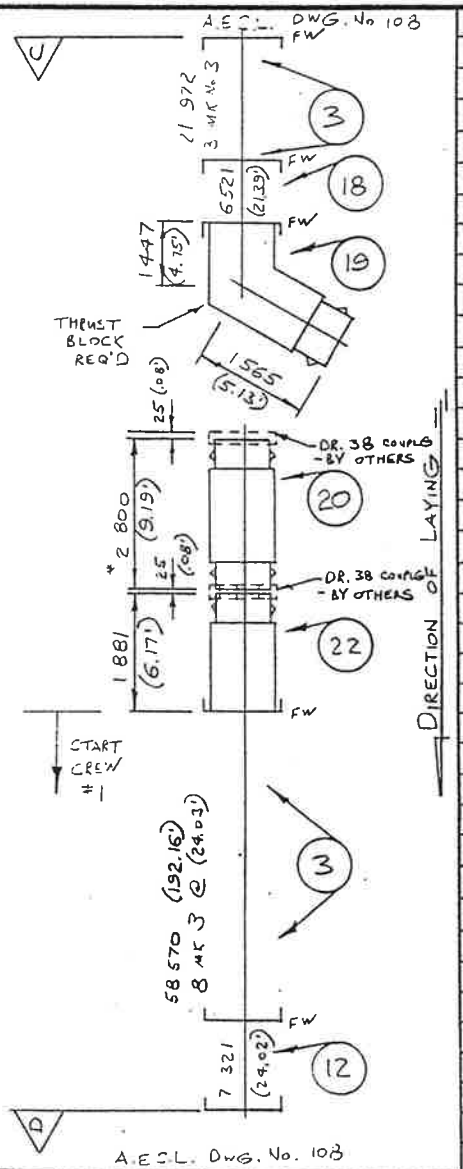
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
15	1	900	64°-01'-55" ELBOW c/w MR	——	C-301-L	B	FWS/B$_{EW}$	91-0121-27	(B) CHAINAGE CONFIRMED (E) "THRUST BLOCK" NOTE DELETED
3	2	900	NSTD c/w MR	7315		10	FWS/B$_{EW}$		
12	1	900	NSTD c/w MR	7315		10	FWS/B		
STP	2	900	STD	7315	C-301-L	10	S/B		
13	1	900	NSTD	7315		10	S/B$_{EW}$		
3	3	900	NSTD c/w MR	7315		10	FWS/B$_{EW}$		
16	1	900	SHORT c/w MR	3211 (10'-6 3/8")		10	FWS/B$_{EW}$		(B) DIMS NOW CONFIRMED
17	1	900/300/600	TEE c/w 600(24") FLG	1524 (5'-0")		B	S/B$_{EW}$/FLG	91-0121-28	

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

Comox-Strathcona S-7
Goose Spit/Cape Lazo

Pw: 350 kPa (51 psi)	Scale: N.T.S.		Date: JUNE 21 1982		
Pw+s: 550 kPa (80 psi)	Drawn by:	Checked by:	Approved by:	Drawing No.	Rev.
Pt: 700 kPa (102 psi)	DAB	GLN.	GLN.	91-0121-5	C



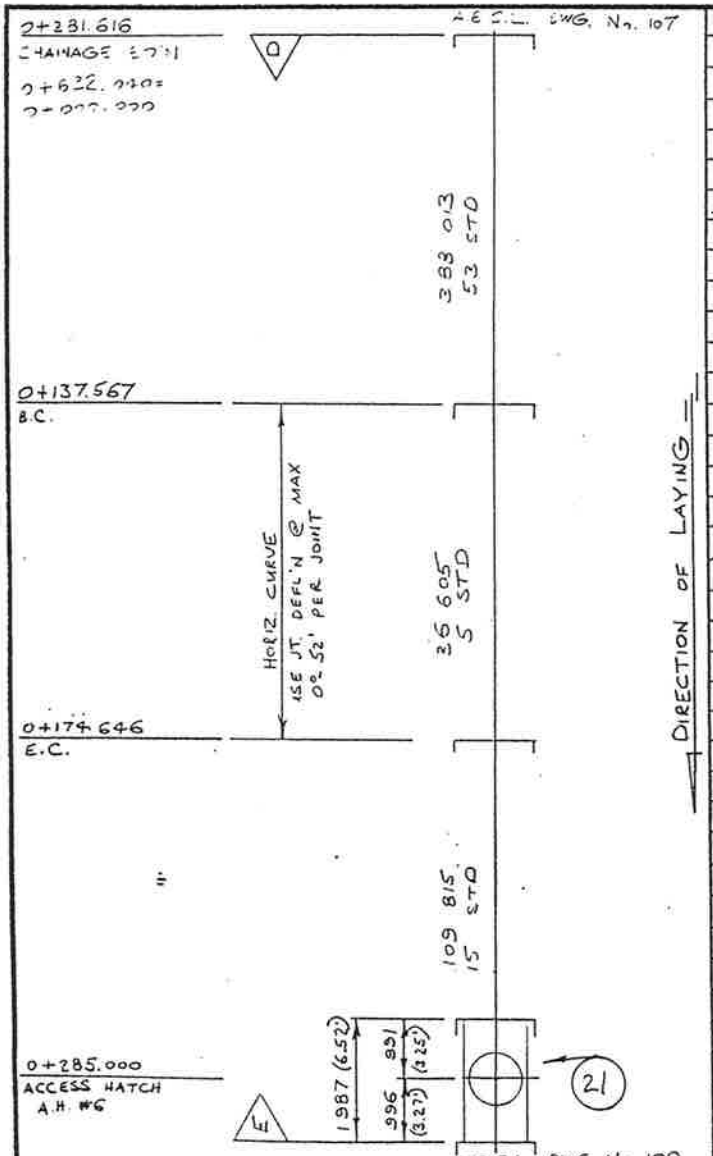
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	C/L TYPE	ENDS	REF. DWG. NO.	REVISIONS
3	2	900	NSTD C/W MR	7315	C-30L	10	FWS/BEW		
18	1	900	SHORT C/W MR	6512 (21'-4 1/8")		10	FWS/BEW		
19	1	900	61°-08'-47" ELBOW C/W PSE TO SUIT COUPLING 2 MR & 4 TIE LUGS (37 15/16" x 3/8") O.D. PSE			B	FWS/PSE	91-0121-29	(C) WAS 2 TIE LUGS (F) ADDED LEG LENGTH TO MK 19
									(F) ADDED CHAINAGE
20	1	900	SHORT C/W (2) PSE TO SUIT DR. 38 COUPLG. (1) TO BE 300 (11 3/4") EXTRA FOR FIELD TRIM & 8 TIE LUGS (37 15/16" x 1/4") O.D. PSE	2800 (9'-2 1/4")		10	PSE/PSE	91-0121-30	(E) WAS 4 TIE LUGS (G) NIPPLE THICK. REV'D (E) LGTH WAS (6'-6")
22	1	900	SHORT C/W PSE TO SUIT DR 38 COUPLG. & 4 TIE LUGS (37 15/16" x 1/4") O.D. PSE	1881 (6'-2")	C-30L	10	FWS/PSE	91-0121-31	(B) LGTH WAS (7'-6 1/4") (C) WAS 2 TIE LUGS (D) MK 22 WAS PSE/B (G) NIPPLE THICK. REV'D
3	8	900	NSTD C/W MR.	7315		10	FWS/BEW		
12	1	900	NSTD C/W MR.	7315		10	-/BEW		

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX-STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 350 kPa (51 psi)	Scale: N.T.S.		Date: JUNE 21 1982		
Pw+s: 550 kPa (80 psi)	Drawn by: JAB	Checked by: [illegible]	Approved by: [illegible]	Drawing No. 91-0121-6	Rev. G
Pt: 700 kPa (102 psi)					



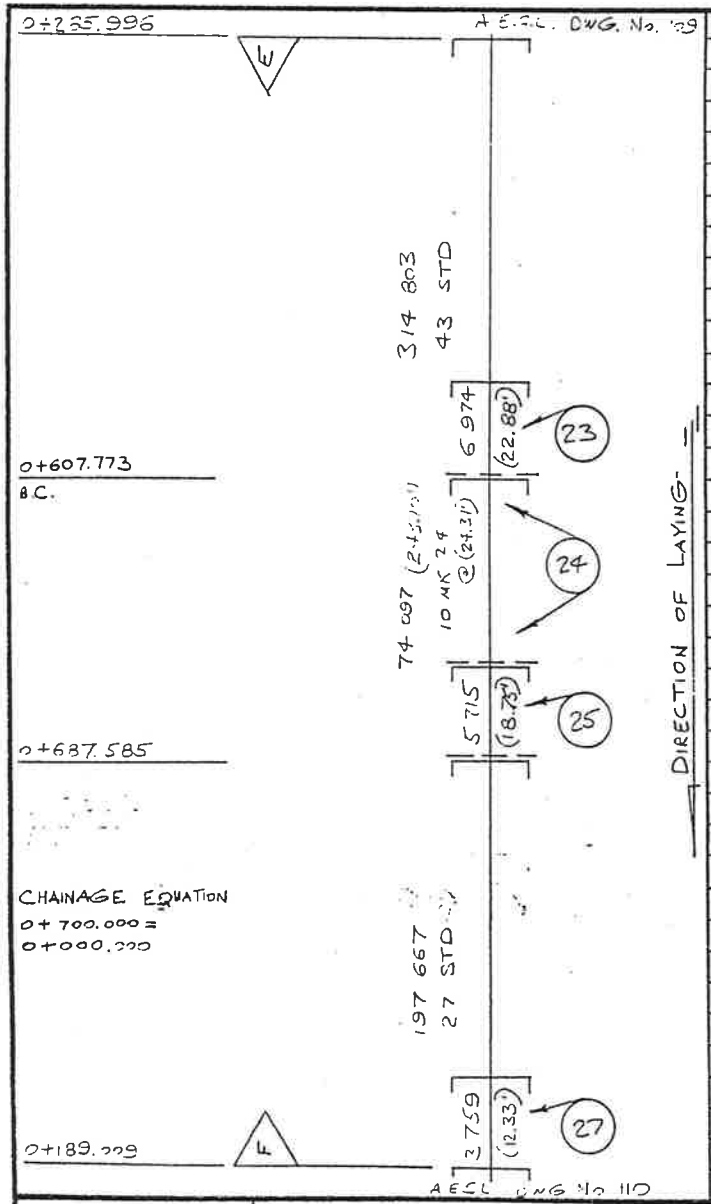
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	S.L. TYPE	ENDS	REF. DWG. NO.	REVISIONS
STD	53	900	STD	7315		10	S/B		
STD	5	900	STD	7315 (24'-0")	C-301-L	10	S/B		
STD	15	900	STD	7315		10	S/B		
21	1	900	TEE	1981 (6'-6")	C-301-L	B	S/B/FLG	91-0121-32	

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 350 kPa (51 psi)	Scale: N.T.S.		Date: JUNE 21 1982		
Pw+s: 550 kPa (80 psi)	Drawn by: DAB	Checked by: AJN	Approved by:	Drawing No. 91-0121-7	Rev. A
Pt: 700 kPa (102 psi)					



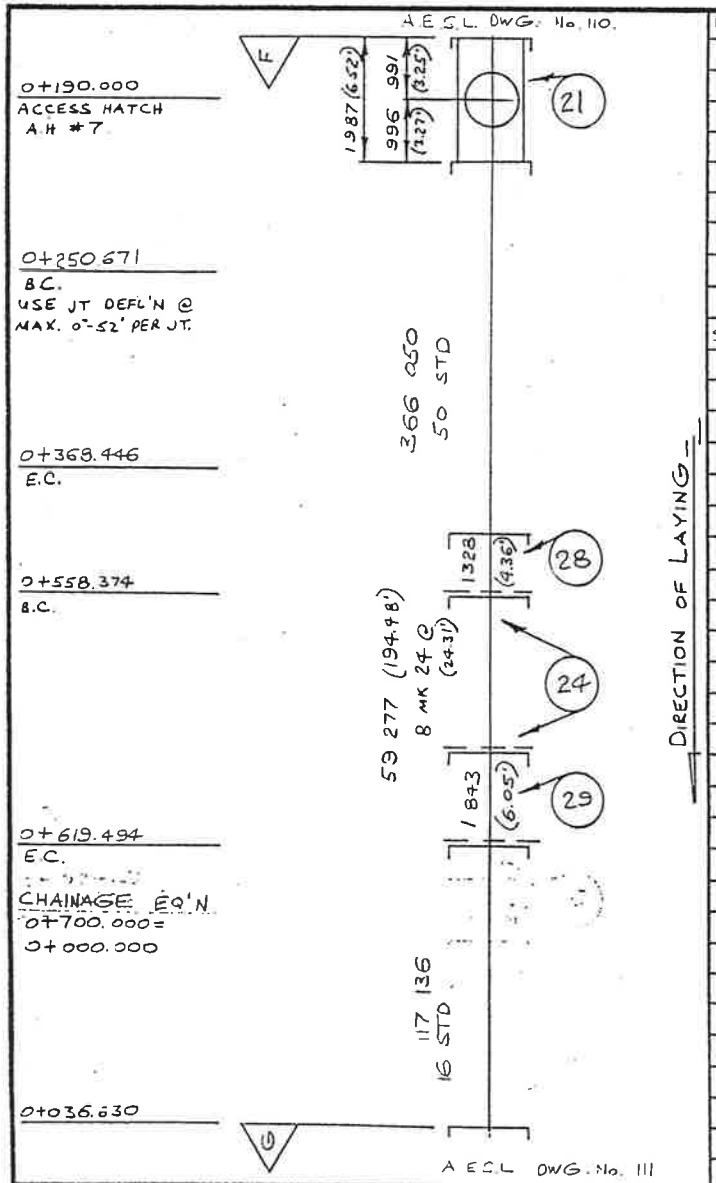
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
STD	43	900	STD	7315		10	S/B		
23	1	900	SHORT c/w 1° BEV BELL	6 968 (22'-10 1/8")	G-301-L	10	S/B	91-0121-33	
24	10	900	NSTD c/w 2° BEV BELL	7 404 (24'-3 1/2")		10	S/B	91-0121-33	
25	1	900	SHORT c/w 1° BEV BELL	5709 (18'-8 3/4")		10	S/B	91-0121-33	WAS 18'-2 3/4"
STD	27	900	STD	7315		10	S/B		
27	1	900	SHORT	3 753 (12'-3 3/4")		10	S/B		

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC.
PIPE DIVISION

COMOX - STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 350 kPa (51 psi)	Scale: N.T.S.		Date: JUNE 21 1982			
Pw+s: 550 kPa (80 psi)	Drawn by: DAB	Checked by: GLM	Approved by: Old.	Drawing No. 91-0121-3	Rev. B	
Pt: 700 kPa (102 psi)						

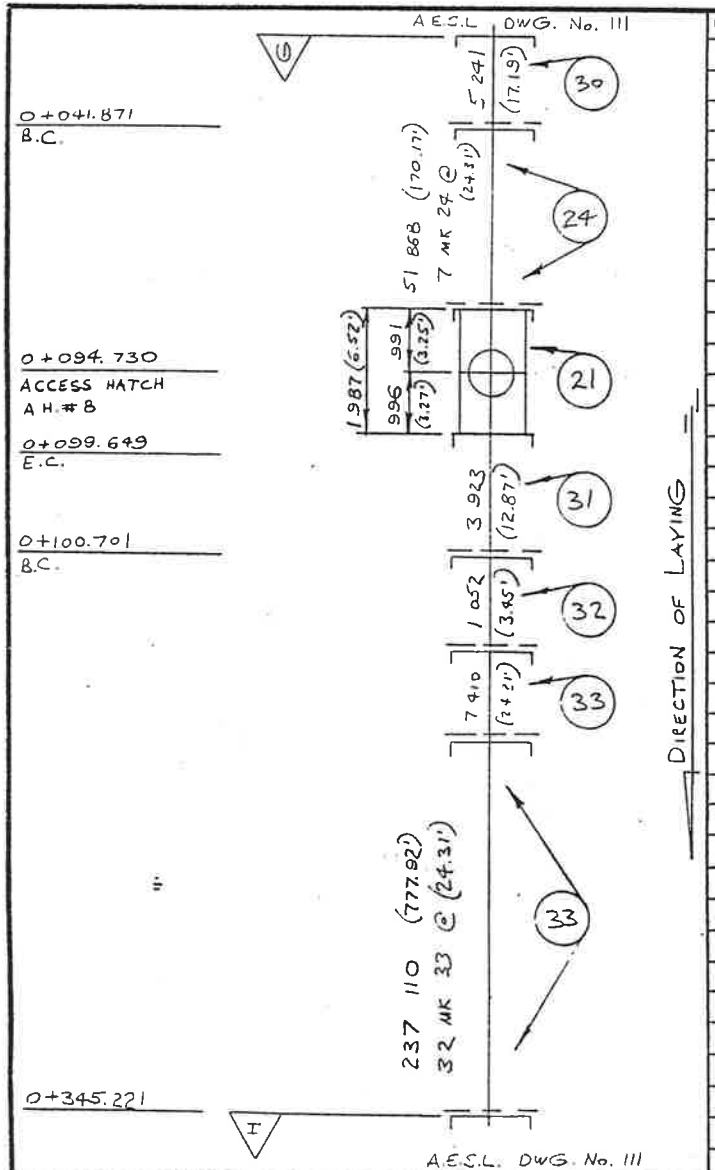


MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	C.L. TYPE	ENDS	REF. DWG. NO.	REVISIONS
21	1	900	TEE	1 981 (6'-6")	C-301-L	B	S/B/FLG	91-0121-32	
									(C) ADDED CHAINAGE FOR CURVE BEGIN.
STD	50	900	STD	7315		10	S/B		P.C. & E.C. WITH A RADIUS OF 48 M MUST BE CONFIRM.
28	1	900	SHORT c/w 1° BEV BELL	1 322 (4'-4 1/8")	C301-L	10	S/B	91-0121-33	
24	8	900	NSTD c/w 2° BEV. BELL	7 404 (24'-3 1/2")		10	S/B	91-0121-33	
29	1	900	SHORT c/w 1° BEV BELL	1 837 (6'-0 3/8")		10	S/B	91-0121-33	
									(B) CHAINAGE EQ'N WAS 0+200. = 0+000.
STD	16	900	STD	7315		10	S/B		
									SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 300 kPa (43 psi)	Scale: NTS.		Date: JUNE 21 1982		
Pw+s: 550 kPa (80 psi)	Drawn by: DAB	Checked by: TWN.	Approved by: GWB.	Drawing No. 91-0121-9	Rev. C
Pt: 700 kPa (102 psi)					



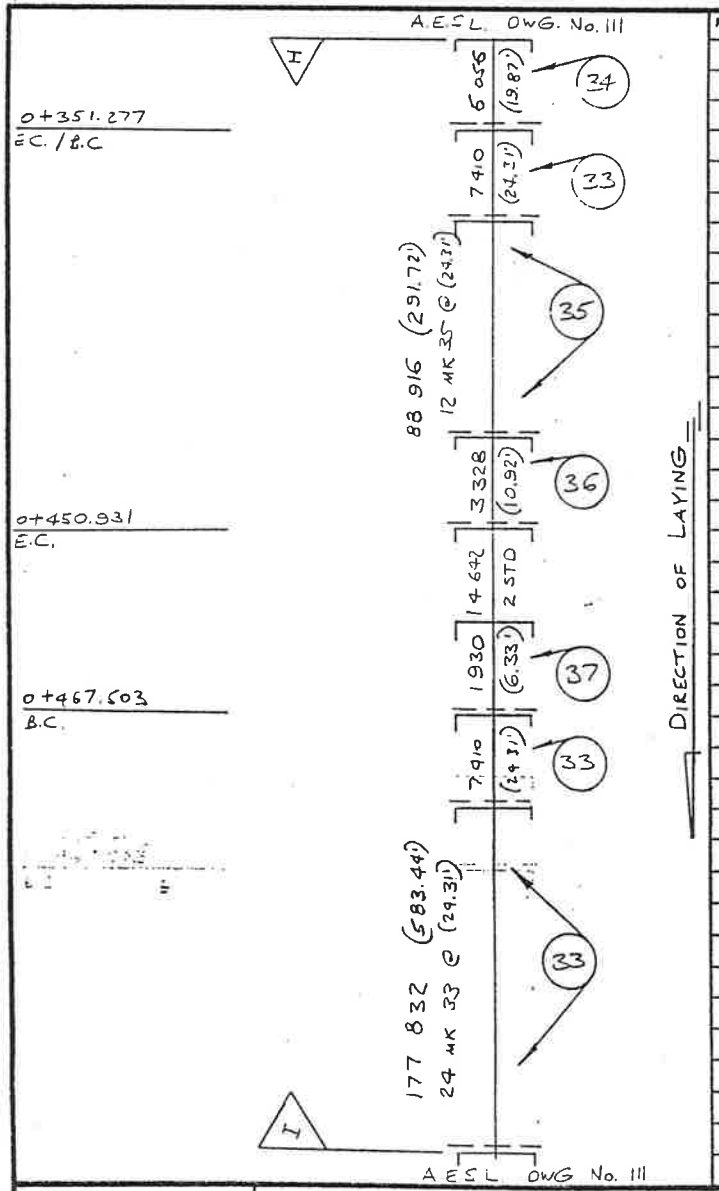
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
30	1	900	SHORT c/w 1° BEV BELL	5235 (17'-2")	C30LL	10	S/B	91-0121-33	
24	7	900	NSTD c/w 2° BEV BELL	7404 (24'-3¼")		10	S/B	91-0121-33	
21	1	900/300/600	TEE	1981 (6'-6")		B	S/B/FLG	91-0121-32	WAS 0+095
31	1	900	SHORT c/w 1° BEV BELL	3917 (12'-10¼")	C30LL	10	S/B	91-0121-34	℄ CHAINAGE WAS 0+099.649
32	1	900	SHORT c/w 1° BEV BELL	1046 (3'-5⅛")		1B	S/B	91-0121-52	WAS DWG. 34
33	1	900	NSTD c/w 1° BEV BELL	7404 (24'-3½")		10	S/B	91-0121-34	
33	32	900	NSTD c/w 1° BEV BELL	7404 (24'-3½")		10	S/B	91-0121-34	

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX-STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw:	300 kPa (43 psi)	Scale: N.T.S.		Date: JUNE 21 1982			
Pw+s:	550 kPa (80 psi)	Drawn by: JAB	Checked by: AHL.	Approved by: CPK.	Drawing No. 91-0121-10	Rev. C	
Pt:	700 kPa (102 psi)						



MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
34	1	900	SHORT c/w 1° BEV BELL	6 050 (19'-10¼")	C-301-L	10	S/B	91-0121-34	
33	1	900	NSTD c/w 1° BEV BELL	7 404 (24'-3½")		10	S/B	91-0121-34	
35	12	900	NSTD c/w 2°30' BEV BELL	7404		10	S/B	91-0121-34	
36	1	900	SHORT c/w 1° BEV BELL	3 322 (10'-10½")		10	S/B	91-0121-34	
STD	2	900	STD	7 315 (24'-0")	C-301-L	10	S/B		
37	1	900	SHORT c/w 1° BEV BELL	1 924 (6'-3¼")		10	S/B	91-0121-34	
33	1	900	NSTD c/w 1° BEV BELL	7 404 (24'-3½")		10	S/B	91-0121-34	
33	24	900	NSTD c/w 1° BEV BELL	7404		10	S/B	91-0121-34	

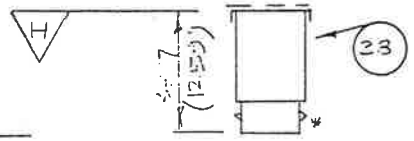
SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX-STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 300 kPa (43 psi)	Scale: N.T.S.		Date: JUNE 21 1982		
Pw+s: 550 kPa (80 psi)	Drawn by: DAB	Checked by: DH	Approved by: DH	Drawing No. 91-0121-11	Rev. A
Pt: 700 kPa (102 psi)					

A.E.S.L. DWG. No. 111



0+656.582
LIMIT OF CONTRACT

+ TEMPORARY TESTING ARRANGEMENT BY CONTRACTOR TO INCLUDE THRUST BLOCKING

MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. TYPE	ENDS	REF. DWG. NO.	REVISIONS
38	1	900	SHORT c/w (35") O.D. PCE (3/8") WALL THICKNESS	3837 (12'-7")	C-301-L	10	S/PCE	91-0121-35	(C) TIE LUGS ADDED
									(D) "WELDING BEVEL" NOTE DELETED

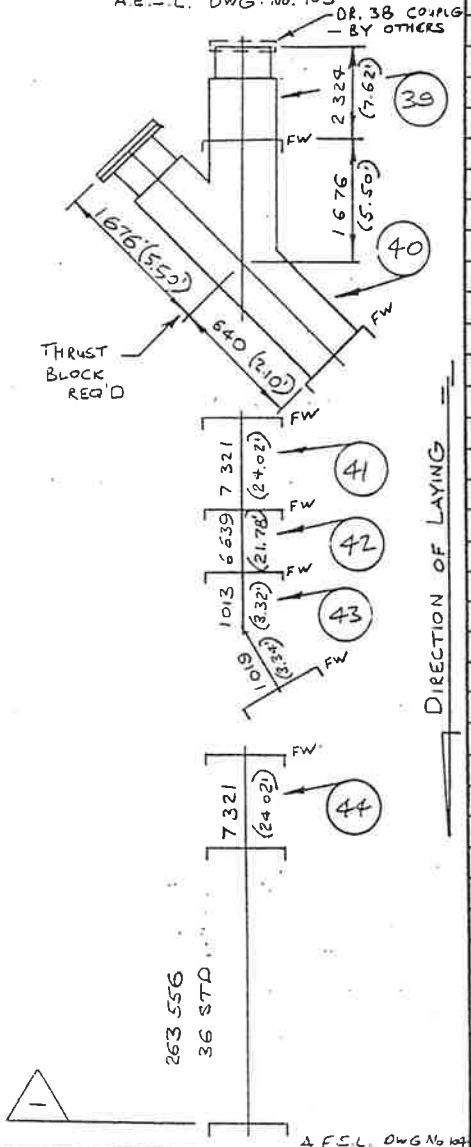
SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION	COMOX-STRATHCONA S-7. GOOSE SPIT / CAPE LAZO	Pw: 350 kPa (51 psi)	Scale: N.T.S		Date: JUNE 21 1982		
		Pw+s: 550 kPa (80 psi)	Drawn by: JAB	Checked by: GWG.	Approved by: DKH.	Drawing No. 91-0121-12	Rev. D
		Pt: 700 kPa (102 psi)					

CHAINAGE EQ'N
0+457.000 =
0+000.000

CONNECT TO 750 C-303 PIPE (S-5)

A.E.S.L. DWG. No. 103



0+004.000
820 x 820 x 820 WYE (45°)

0+019.613
24°-38' H.B.L.

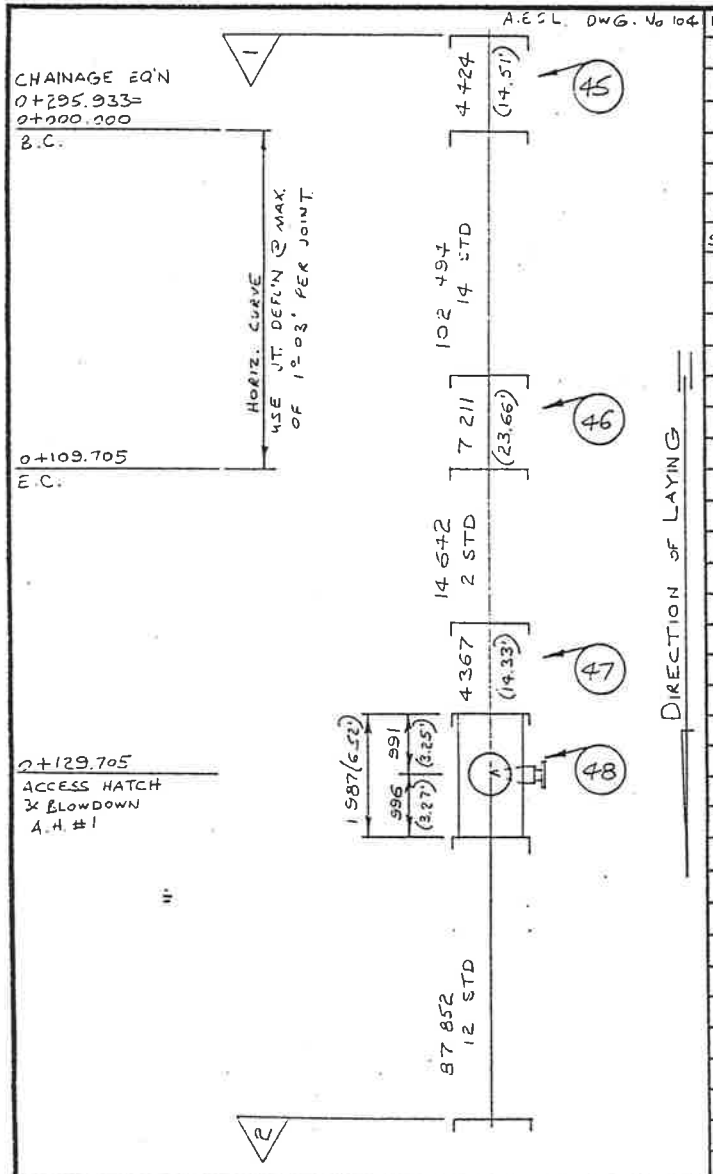
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL. TYPE	ENDS	REF. DWG. NO.	REVISIONS
39	1	820 (32¼")	SHORT c/w PSE TO SUIT 32-3D & 4 TIE LUGS (34½" X ⅜") O.D PSE	2318 (7'-7¼")	C-303	100	PSE/B&W	91-0121-36	(b) WAS 2 TIE LUGS (c) ADDED O.D PSE DIMS
40	1	820/820/820	45° WYE c/w NR C20 RLD FLG & NR	2310 (7'-7")	C-303	B	FLG/B&W/SFW	91-0121-37	
41	1	820	NSTD c/w NR	7315		100	FWS/B&W		
42	1	820	SHORT c/w NR	6633 (21'-9⅛")		100	FWS/B&W		
43	1	820	24°-38' ELBOW c/w NR	——	C-303	B	FWS/B&W	91-0121-38	(d) DELETED "THRUST BLOCK" NOTE
44	1	820	NSTD c/w NR	7315 (24'-0")		100	FWS/B		
STD	36	820	STD	7315		100	S/B		

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 700 kPa (29 psi)	Scale: N.T.S.		Date: JUNE 21 1982		
Pw+s: 2.0 kPa (44 psi)	Drawn by: DAB	Checked by: GLN.	Approved by: GLS	Drawing No. 91-0121-13	Rev. D
Pt: 700 kPa (102 psi)					



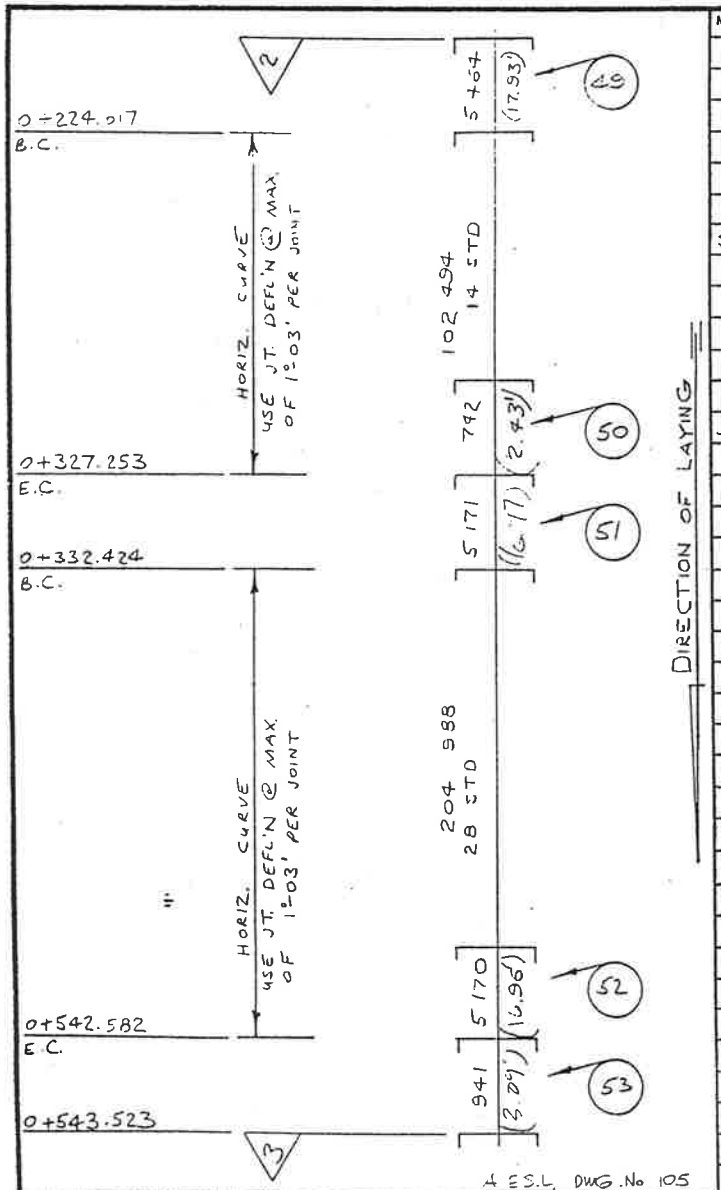
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
45	1	820	SHORT	4 418 (14'-5 7/8")	C-303	100	S/B		
STD	14	820	STD	7315 (24'-0")	C-303	100	S/B		
46	1	820	SHORT	7205 (23'-7 5/8")	C-303	100	S/B		
STD	2	820	STD	7315	C-303	100	S/B		
47	1	820	SHORT	4361 (14'-3 3/4")	C-303	100	S/B		
48	1	820/610/300	TEE c/w 200 (8") FLG'D BR BOTT. TANG.	1981 (6'-6")	C-303	B	S/B/FLG	91-0121-39	
STD	12	820	STD	7315	C-303	100	S/B		

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC.
PIPE DIVISION

COMOX - STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 200 kPa (29 psi)	Scale: N.T.S		Date: JUNE 21 1982				
Pw+s: 300 kPa (43 psi)	Drawn by: DAB	Checked by: GHL	Approved by: GHL	Drawing No. 91-0121-14	Rev. A
Pt: 700 kPa (102 psi)					

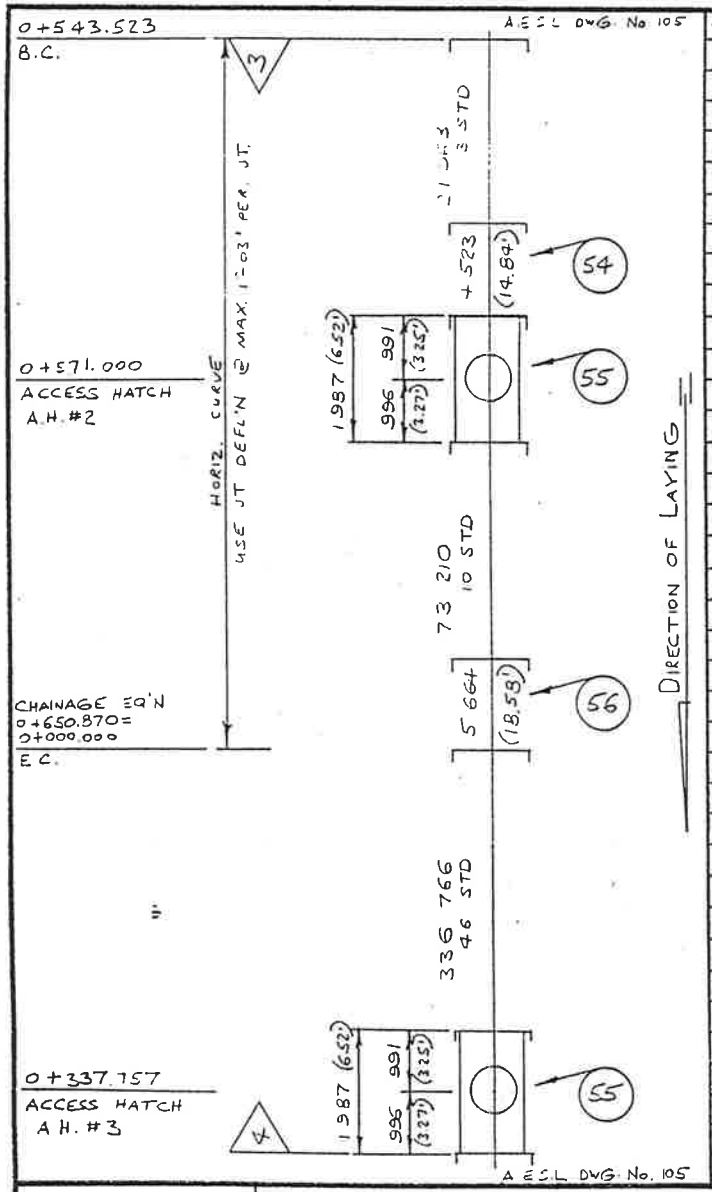


MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	Cpl. TYPE	ENDS	REF. DWG. NO.	REVISIONS
49	1	820	SHORT	5 458 (17'-10 1/8")	C-303	100	S/B		(B) ADDED DIMENSIONS
STD	14	820	STD	7 315 (24'-0")	C-303	100	S/B		
50	1	820	SHORT	736 (2'-4 7/8")	C-303	100	S/B		(B) WAS 19'-4 1/2")
51	1	820	SHORT	5 165 (16'-11 3/8")	C-303	100	S/B		
STD	28	820	STD	7 315	C-303	100	S/B		
52	1	820	SHORT	5 164 (16'-11 1/4")	C-303	100	S/B		(B) WAS 116'-9 3/8")
53	1	820	SHORT	936 (3'-0 7/8")	C-303	100	S/B		
									SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX-STRATHCONA S-7
GOOSE SPIT/CAPE LAZO

Pw: 200 kPa (29 psi)	Scale: N.T.S.		Date: JUNE 21 1982		
Pw+s: 300 kPa (43 psi)	Drawn by: DAB	Checked by: AAL	Approved by: AAL	Drawing No. 91-0121-15	Rev. B
Pt: 700 kPa (102 psi)					



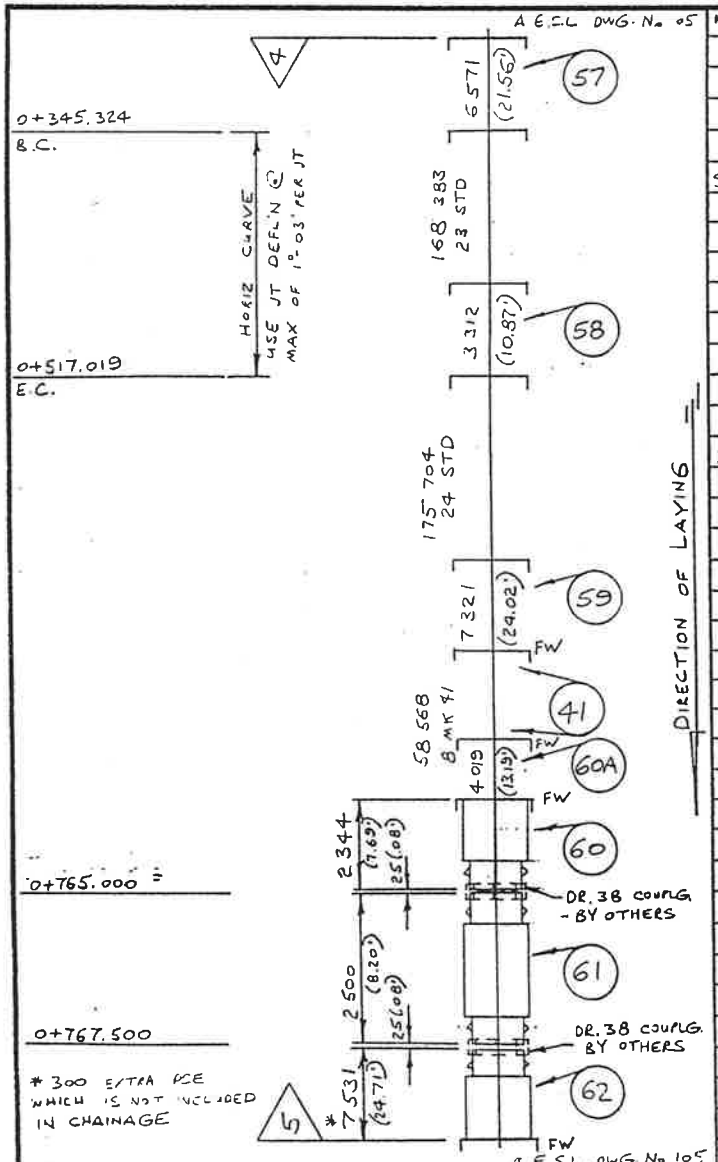
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	C.L. TYPE	ENDS	REF. DWG. NO.	REVISIONS
STD	3	820	STD	7315	C-303	100	S/B		
54	1	820	SHORT	4517 (14'-9 1/8")	C-303	100	S/B		
55	1	820/820	TEE	1981 (6'-6")	C-303	B	S/B/FLG	91-0121-40	
STD	10	820	STD	7315	C-303	100	S/B		
56	1	820	SHORT		C-303	100	S/B		
STD	46	820	STD	7315	C-303	100	S/B		
55	1	820/820	TEE	1981 (6'-6")	C-303	100	S/B/FLG	91-0121-40	

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX-STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 200 kPa (29 psi)	Scale: N.T.S		Date: JUNE 21 1982			
Pw+s: 300 kPa (43 psi)	Drawn by: DAR	Checked by: WN	Approved by: WN	Drawing No. 91-0121-6	Rev. A
Pt: 200 kPa (102 psi)					

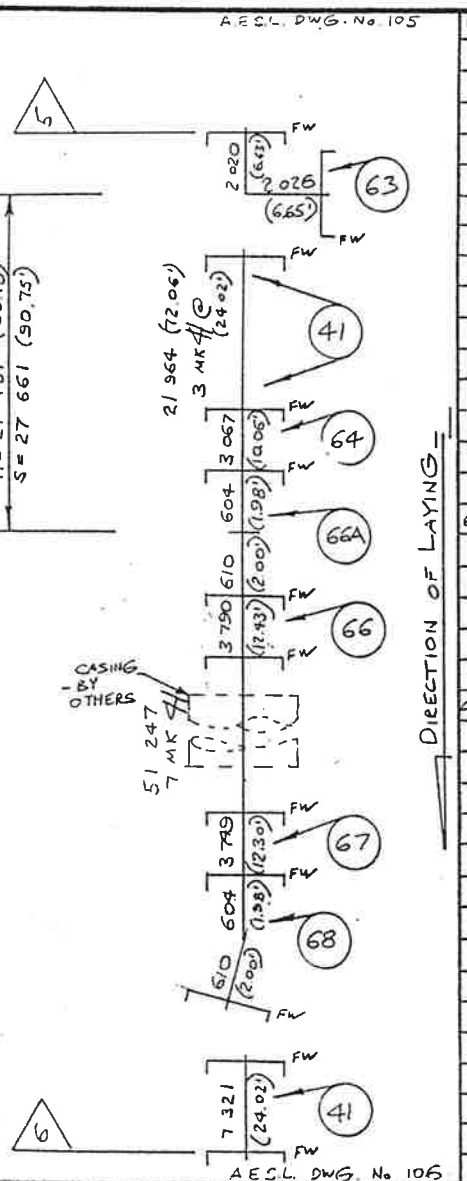


MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
57	1	820	SHORT	6 565 (21'-6½")	C-303	100	S/B		
STD	23	820	STD	7 315 (24'-0")		100	S/B		
58	1	820	SHORT	3 306 (10'-10¼")		100	S/B		
STD	24	820	STD	7 315		100	S/B		
59	1	820	NSTD	7 315		100	S/BFW		
41	3	820	NSTD C/W WR	7 315	C-303	100	FW S/BFW		
60A	1	820	SHORT C/W WR	4 013 (13'-2⅛")		100	FW S/BFW		(E) ADDED MK 60A
60	1	820	SHORT C/W PSE TO SUIT DR. 38 COUPLG. WR. & 4 TIE LUGS (34½" x ⅜") O.D PSE	2 344 (7'-8¼")		100	S/PSE	91-0121-41	(B) ADDED "TIE LUGS" (C) WAS 2 TIE LUGS (D) ADDED OD PSE DIMS (E) MK 60 METRIC CONVERSION WRONG
61	1	820	SHORT C/W (2) PSE TO SUIT DR. 38 COUPLG. & 8 TIE LUGS (34½" x ⅜") O.D. PSE	2500 (8'-2¾")		100	PSE/PSE	91-0121-42	(C) WAS 4 TIE LUGS (D) ADDED OD PSE DIMS (D) ADDED OD PSE DIMS.
62	1	820	SHORT C/W 300 EXTRA PSE TO SUIT DR 38 COUPLG & 4 TIE LUGS (34½" x ⅜") OD PSE.	7 525 (24'-8⅛")		100	PSE/BFW	91-0121-43	(B) ADDED "EXTRA" (C) WAS 2 TIE LUGS SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 200 kPa (29 psi)	Scale: N.T.S.		Date: JUNE 21 1982		
Pw+s: 300 kPa (43 psi)	Drawn by: DAB	Checked by: GHK	Approved by: GHK	Drawing No. 91-0121-17	Rev. E
Pt: 700 kPa (102 psi)					



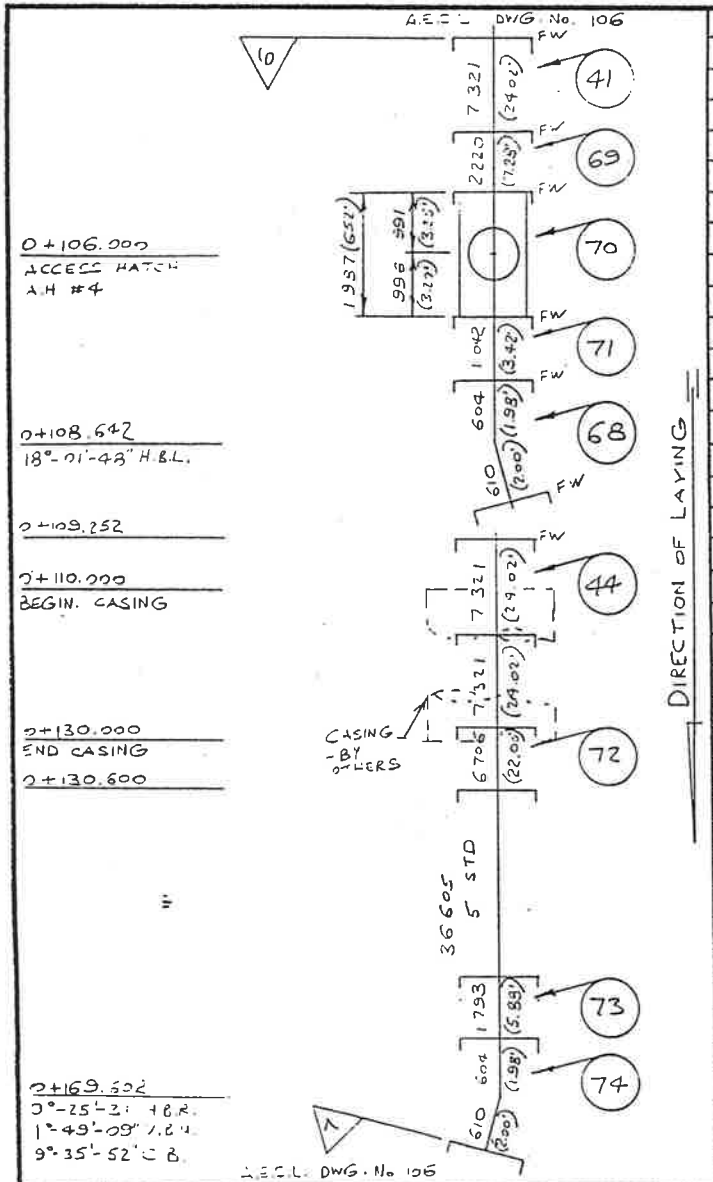
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
63	1	820	88°-59'-46" ELBOW c/w WR	——		B	FWS/BFW	91-0121-44	
41	3	820	NSTD c/w WR	7315		100	FWS/BFW		
64	1	820	SHORT c/w WR.	3061 (10'-0½")		100	FWS/BFW		
66A	1	820	5°-28'-00" BEV ADAPTOR c/w WR.	——		B	FWS/BFW	91-0121-53	(B) DELETED "THRUST BLOCK NOTES (C) DELETED MK 65 ADDED MK 66 A
66	1	820	SHORT c/w WR	3784 (12'-5")		100	FWS/BFW		
41	7	820	NSTD c/w WR	7315 (24'-0")	C-303	100	FWS/BFW		
67	1	820	SHORT c/w WR.	3743 (12'-3⅜")		100	FWS/BFW		
68	1	820	18°-01'-48" ELBOW c/w WR			B	FWS/BFW	91-0121-46	
41	1	820	NSTD c/w WR	7315		100	FWS/BFW		

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 200 kPa (29 psi)	Scale: N.T.S.		Date: JUNE 21 1982			
Pw+s: 300 kPa (43 psi)	Drawn by: DAB	Checked by: GJH	Approved by: GJH	Drawing No. 91-0121-18	Rev. C	
Pt: 700 kPa (102 psi)						



MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
41	1	820	NSTD c/w WR	7315 (24'-0")	C-303	100	FWS/BFW		
69	1	820	SHORT c/w WR	2214 (7'-3 1/8")	C-303	100	FWS/BFW		
70	1	819/820	TEE c/w WR	1931 (6'-6")	C-302	B	FWS/BFW/FWS	91-0121-47	
71	1	820	SHORT c/w WR	1036 (3'-4 1/8")	C-303	100	FWS/BFW		
68	1	820	18°-01'-48" ELBOW c/w WR		C-302	B	FWS/BFW	91-0121-46	(B) DELETED "THRUST BLOCK" NOTES
44	1	820	NSTD c/w WR	7315	C-303	100	FWS/B		
STD	1	820	STD	7315	C-303	100	S/B		
72	1	820	SHORT	6700 (21'-11 3/4")	C-303	100	S/B		
STD	5	820	STD	7315	C-303	100	S/B		
73	1	820	SHORT	1787 (5'-10 1/4")	C-303	100	S/B		
74	1	820	9°-35'-52" BEVEL ADAPTOR		C-303	B	S/B	91-0121-48	

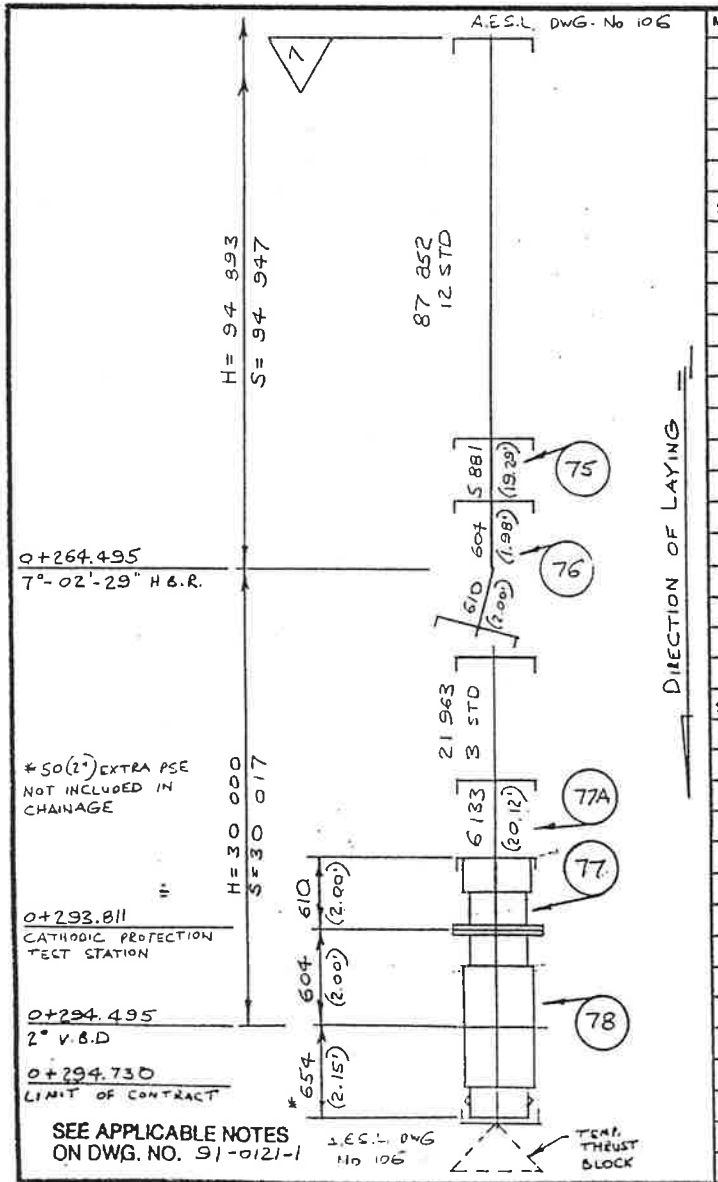
SEE APPLICABLE NOTES ON DWG. NO. 91-0110-1

CANRON INC. PIPE DIVISION

COMOX - STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 200 kPa (29 psi)
Pw+s: 300 kPa (43 psi)
Pt: 700 kPa (102 psi)

Scale: N.T.S.
Date: JUNE 21 1982
Drawn by: JAB
Checked by: AHK
Approved by: AHK
Drawing No. 91-0121-19
Rev. B



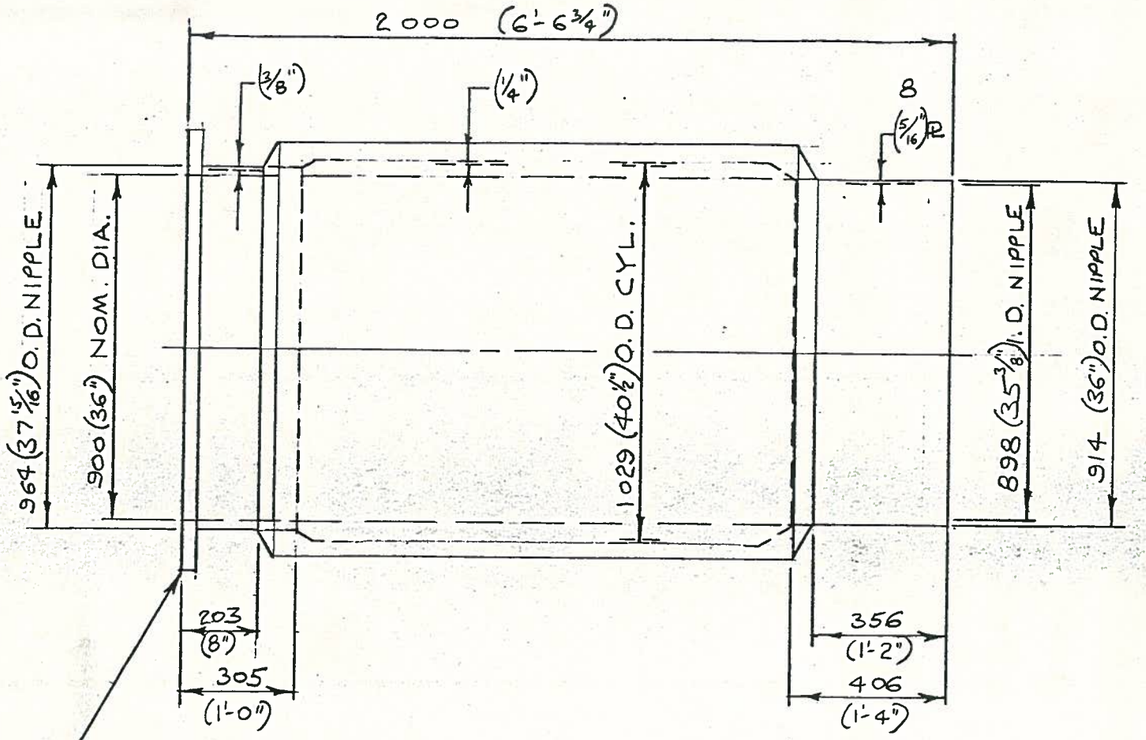
MK. No.	QTY.	DIA.	DESCRIPTION	LENGTH	SPEC.	CL TYPE	ENDS	REF. DWG. NO.	REVISIONS
STD	12	820	STD	7315 (24'-0")	C-302	100	S/B		
75	1	820	SHORT	5 875 (19'-3¼")		100	S/B		
76	1	820	7°-02'-29" BEVEL ADAPTOR	—	C-303	B	S/B	91-0121-49	
STD	3	820	STD	7315		100	S/B		
77A	1	820	SHORT	6 127 (20'-1¼")		100	S/B		(B) ADDED MK 77A
77	1	820	SHORT	610 (2'-0")		B	S/FLG	91-0121-50	(B) CHANGED TO "B" FITTING
78	1	820	2° BEVEL ADAPTOR c/w 864 (34") O.D. PSE & (2") EXTRA PSE 24 TIE LUGS.	—		B	FLG/PSE	91-0121-51	(C) WAS 2 TIE LUGS (D) WAS (33 7/16") O.D.

SEE APPLICABLE NOTES ON DWG. NO. 91-0121-1

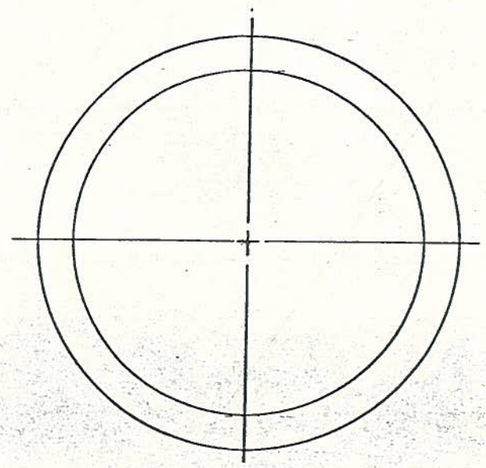
CANRON INC. PIPE DIVISION

COMOX-STRATHCONA S-7
GOOSE SPIT / CAPE LAZO

Pw: 200 kPa (29 psi)	Scale: N.T.S		Date: JUNE 21 1982			
Pw+s: 300 kPa (43 psi)	Drawn by:	Checked by:	Approved by:	Drawing No.	Rev.
Pt: 700 kPa (102 psi)	DAB	DH	DH.	91-0121-20	D



900(36")ø PLATE STEEL FLG.
AWWA C-207 CL. D.
REF. No A-5-S-40



VIEW AT PSE.

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY [signature] DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C301-L
TYPE	: B
~~CLASS~~/PRESSURE	: (102 PSI)
PLATE THICKNESS	: SEE ABOVE
WIRE MESH—INSIDE	: REF. No. A-5-X-133
OUTSIDE	:
WALL THICKNESS	: (3⅞")

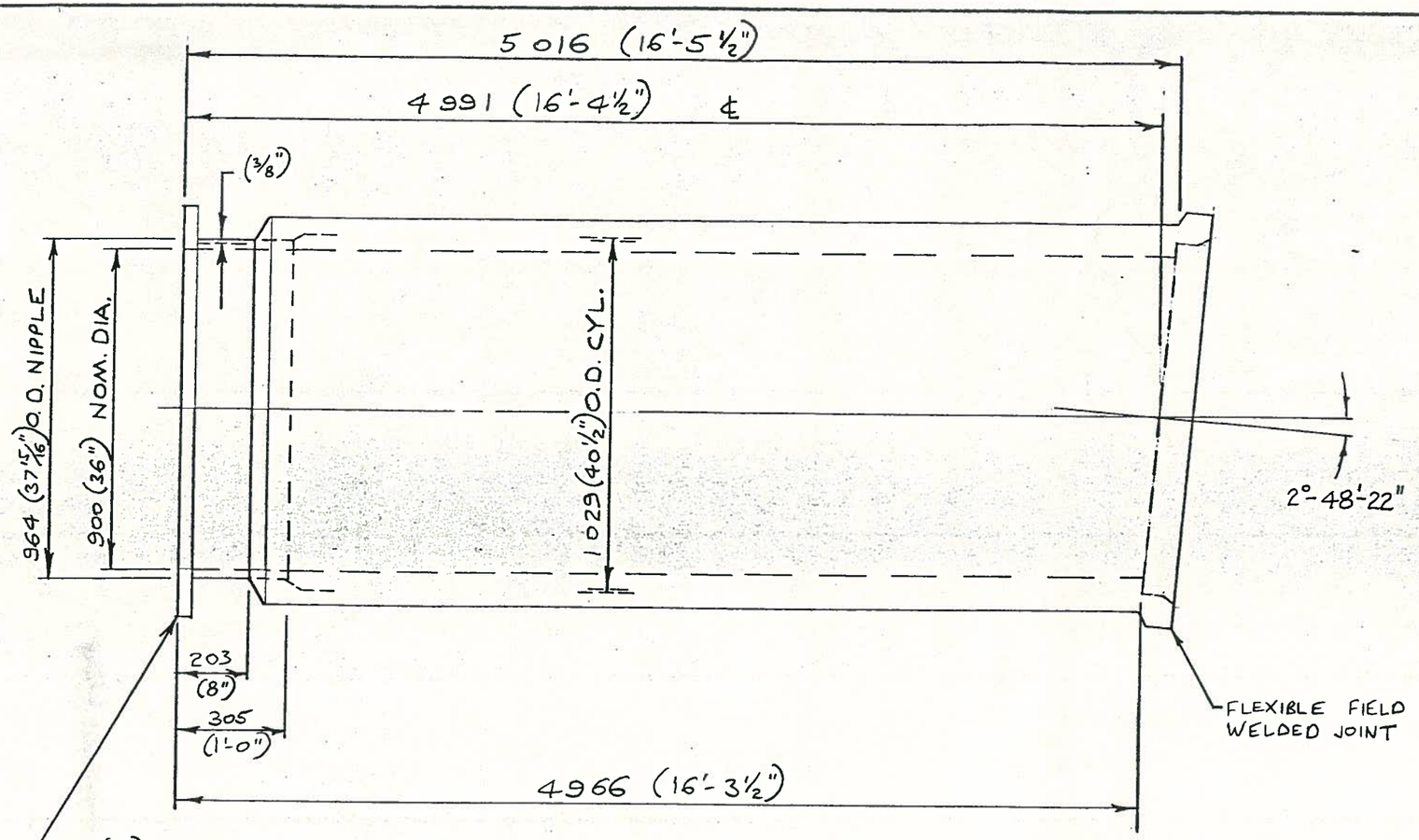
(⅝") EXTRA COATING INCLUDED

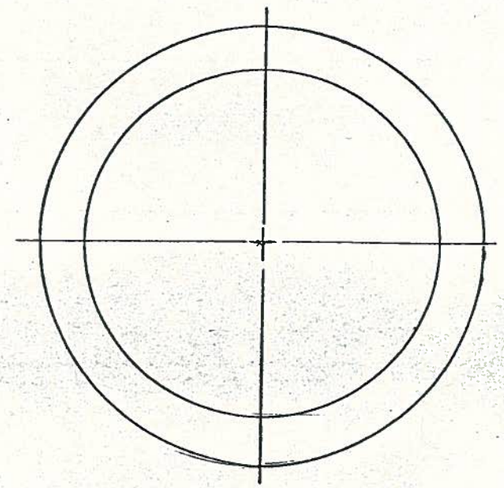
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK. No. 1

Scale: N.T.S.		Date: JULY 19 1982		
Drawn by: DAB	Checked by: AHL.	Approved by:	Drawing No. 91-0121-21	Rev.





VIEW AT BELL END

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY [signature] DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C301-L
TYPE	: A
CLASS/~~PRESSURE~~	: 10
PLATE THICKNESS	: —
WIRE MESH—INSIDE	: —
OUTSIDE	: —
WALL THICKNESS	: (3¾")

(5/8") EXTRA COATING INCLUDED

REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX - STRATHCONA S-7
DETAIL OF MK. No. 2

Scale: N.T.S.		Date: JULY 19 1982		
Drawn by: JAB	Checked by:	Approved by:	Drawing No. 91-0121-22	Rev.

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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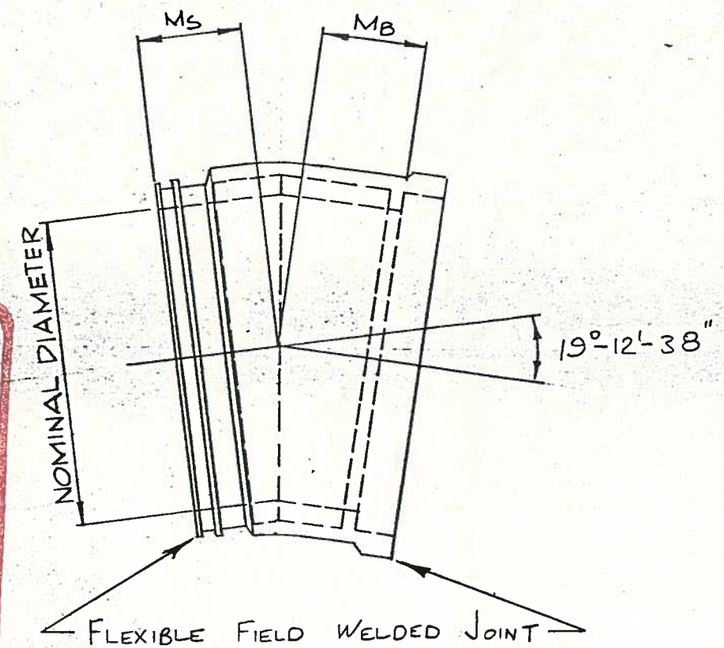
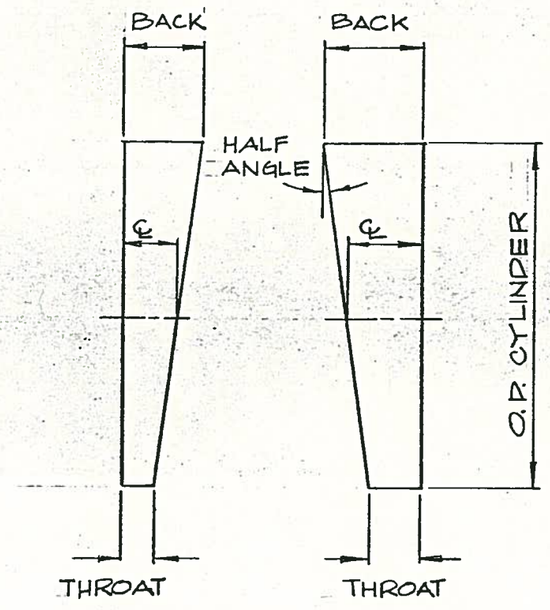
BY _____ DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD

AESL



FULL ANGLE 19°-12'-38"
HALF ANGLE 9°-36'-19"



TANG.	RADIUS	NOM. DIA.	O.D. CYL.	Ms	MB	SPIGOT SEG.			BELL SEG.		
						BACK	℄	THROAT	BACK	℄	THROAT
1'-0½"	6'-1⅞"	36"	40½"	2'-0⅜"	2'-0⅜"	23 3/16"	20⅜"	16 15/16"	26 13/16"	23⅜"	19 15/16"
318	1876	900	1029	618	618						

TYPE V CEMENT COATING & LINING

SPECIFICATION : AWWA C301-L
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (¼") ℞
WIRE MESH—INSIDE } : REF. No A-5-X-133
OUTSIDE }
WALL THICKNESS : (3⅞")
(⅝") EXTRA COATING INCLUDED

REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK. No. 7

Scale: N.T.S.		Date: JULY 14 1982		
Drawn by: DAB	Checked by: ANL	Approved by: ANL	Drawing No. 91-0121-23	Rev.

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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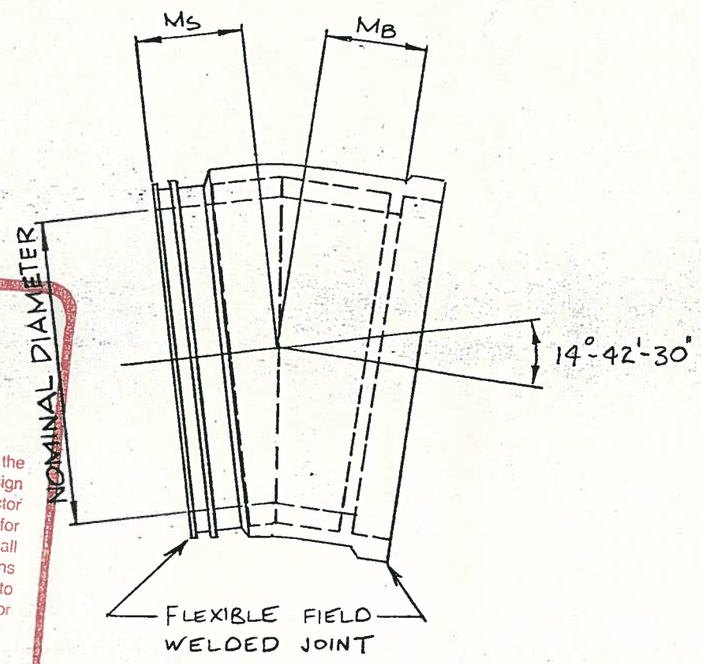
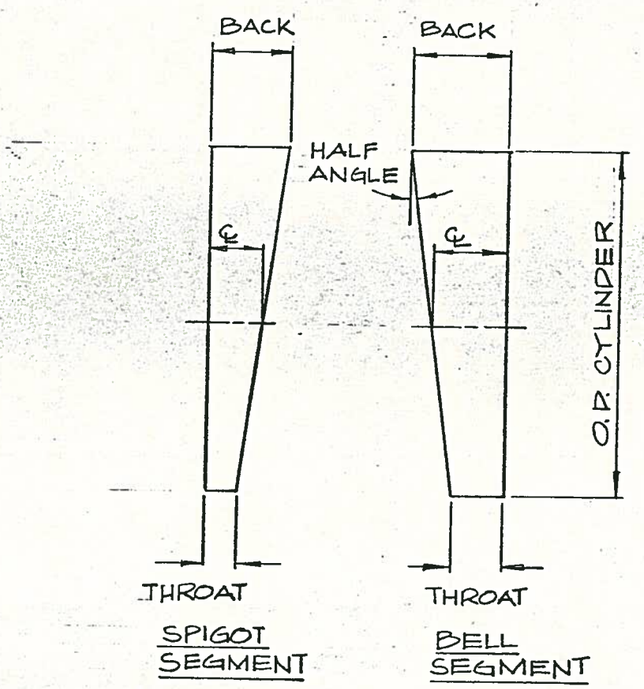
BY Duranca DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD

AESL



FULL ANGLE 14°-42'-30"
HALF ANGLE 7°-21'-15"



SPIGOT SEGMENT

BELL SEGMENT

TANG.	RADIUS	NOM. DIA.	O.D. CYL.	Ms	MB	SPIGOT SEG.			BELL SEG.		
						BACK	℄	THROAT	BACK	℄	THROAT
1'-0½"	8'-0⅞"	36"	40½"	4'-9⅞"	2'-0⅜"	56½"	53⅞"	51¼"	26"	23⅜"	20¾"
318	2459	900	1029	1469	618						

TYPE V CEMENT COATING & LINING

SPECIFICATION : AWWA C301-L
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (¼") ℄
WIRE MESH—INSIDE: } REF. No. A-5-X-133
OUTSIDE: }
WALL THICKNESS : (3⅞")
(⅝") EXTRA COATING INCLUDED

REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK. No. 8

Scale: N.T.S.		Date: JULY 13 1982		
Drawn by: DAB	Checked by: AM	Approved by: AM.	Drawing No. 91-0121-24	Rev.

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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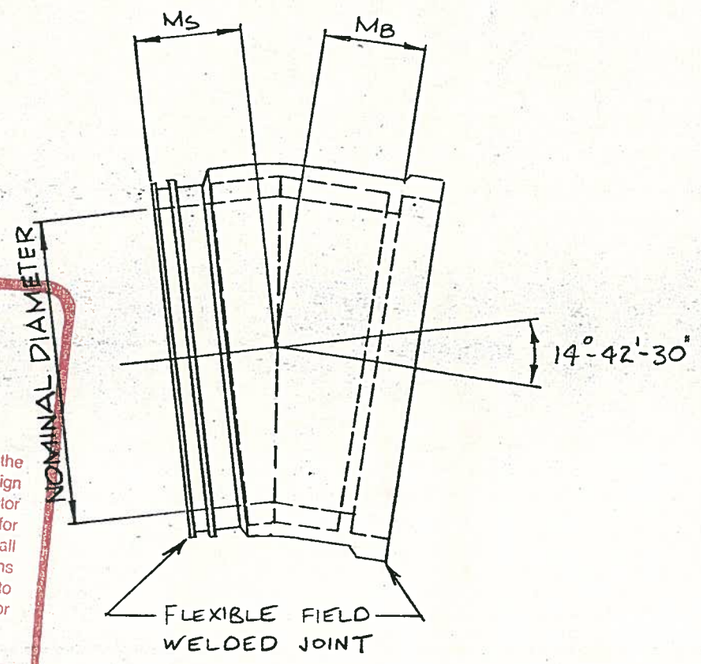
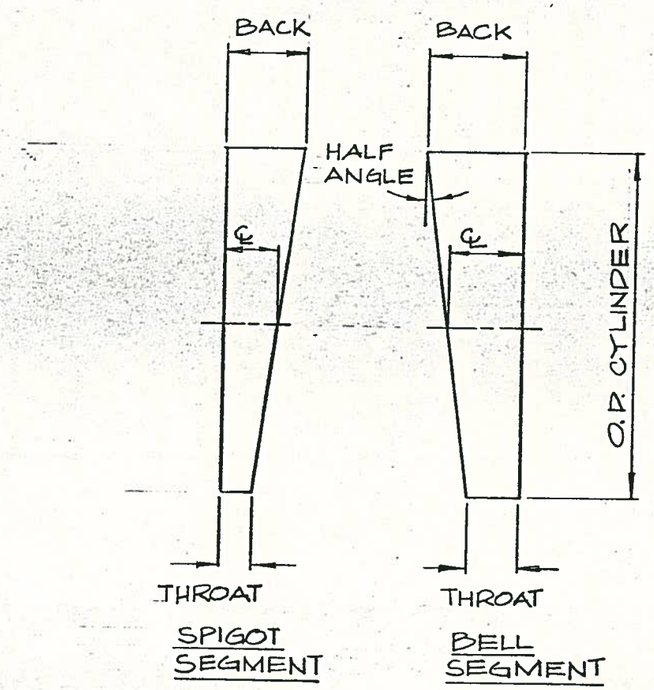
BY Duncan DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD

AESL



FULL ANGLE 14°-42'-30"
HALF ANGLE 7°-21'-15"



SPIGOT SEGMENT

BELL SEGMENT

TANG.	RADIUS	NOM. DIA.	O.D. CYL.	Ms	MB	SPIGOT SEG.			BELL SEG.		
						BACK	℄	THROAT	BACK	℄	THROAT
1'-0½"	8'-0⅞"	36"	40½"	4'-9⅞"	2'-0⅜"	56½"	53⅞"	51¼"	26"	23⅜"	20¾"
318	2459	900	1029	1469	618						

TYPE V CEMENT COATING & LINING

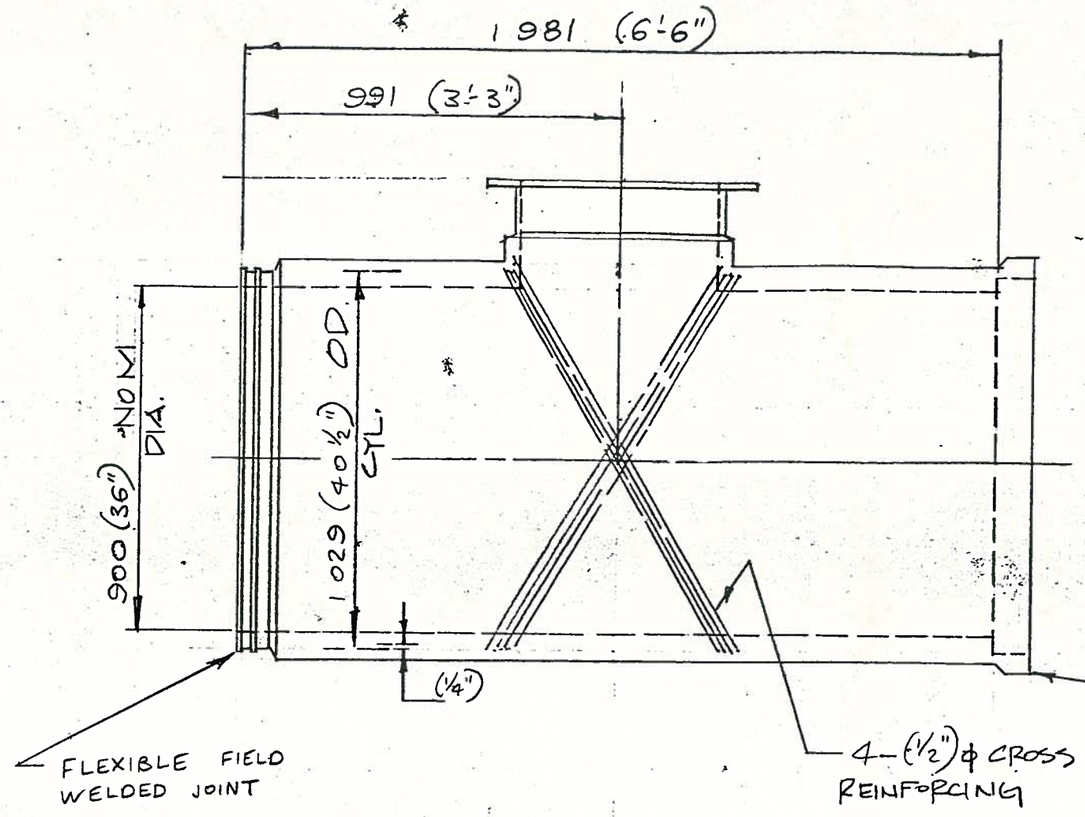
SPECIFICATION : AWWA C301-L
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (¼") ℄
WIRE MESH—INSIDE: } REF. No. A-5-X-133
OUTSIDE: }
WALL THICKNESS : (3⅞")
(⅝") EXTRA COATING INCLUDED

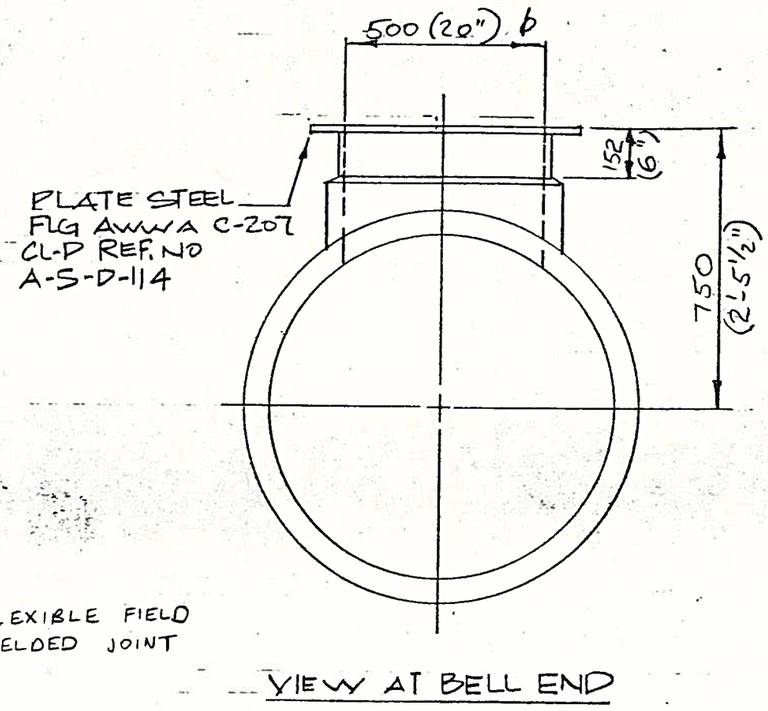
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK. No. 8

Scale: N.T.S.		Date: JULY 13 1982		
Drawn by: DAB	Checked by: AH	Approved by: AH.	Drawing No. 91-0121-24	Rev.





VIEW AT BELL END

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY _____ DATE July 30, 1982

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

TYPE V CEMENT COATING & LINING

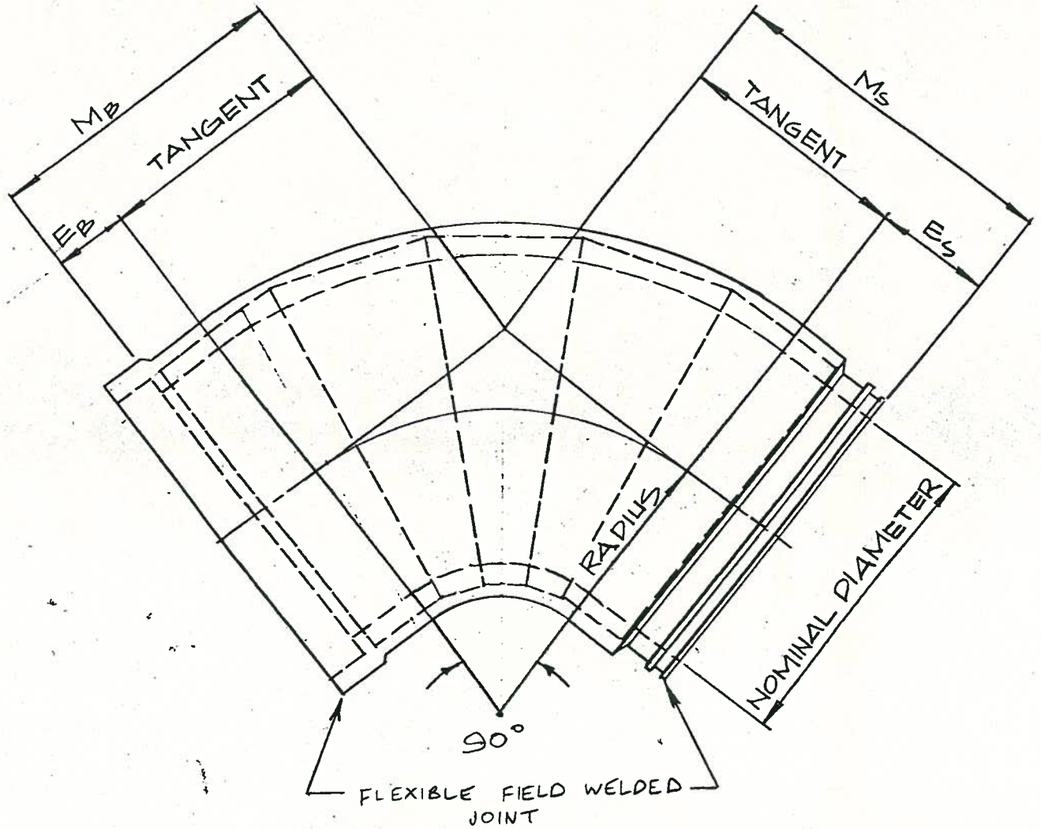
SPECIFICATION : AWWA C301 (L)
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (¼")
WIRE MESH—INSIDE : 3 A-5-X-133
OUTSIDE :
WALL THICKNESS : (3⅞")
(6⅛") EXTRA COATING INCLUDED

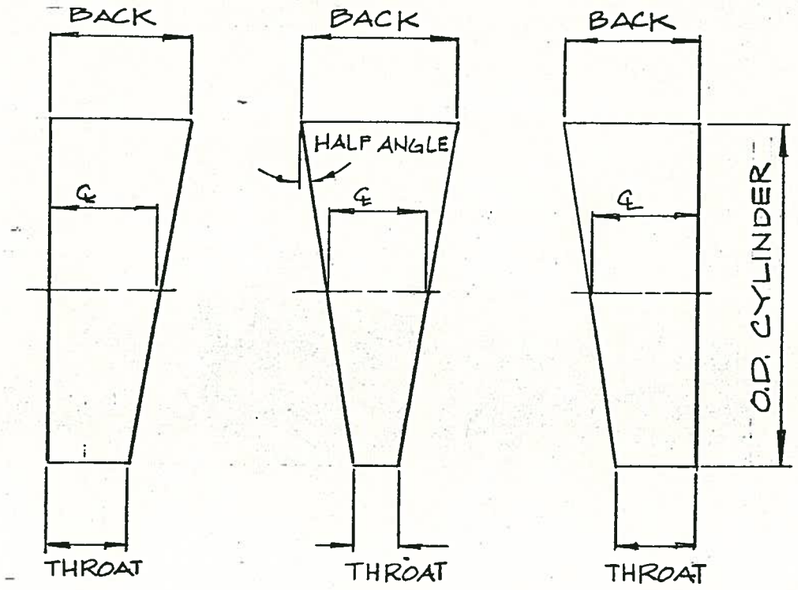
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 10

Scale: NTS		Date: 01/07/82		
Drawn by: RR	Checked by: ORL	Approved by:	Drawing No. 91-0121-25	Rev.





FULL ANGLE 22°-30'
HALF ANGLE 11°-15'

NOM DIA.	O.D CYL.	RADIUS	M_B	M_S	TANG.	E_B	E_S	BELL SEG. BACK	BELL SEG. ℄	BELL SEG. THROAT	STD SEG. BACK	STD SEG. ℄	STD SEG. THROAT	SPIGOT SEG BACK	SPIGOT SEG ℄	SPIGOT SEG THROAT
36"	40½"	5'-10⅞"	6'-10¼"	9'-5⅞"	5'-10⅞"	11⅞"	43"	28⅞"	24⅞"	20⅞"	36 5/16"	28¼"	20 3/16"	57 1/16"	53 1/16"	49 1/16"
90	1029	1800	2180	2852	1800											

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY [signature] DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD

TYPE V CEMENT COATING & LINING

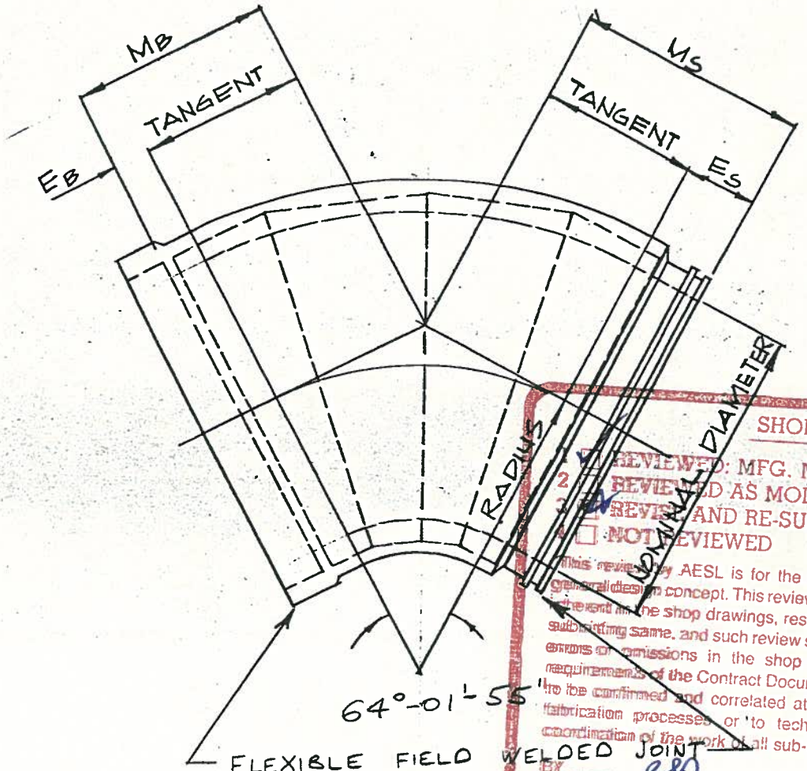
SPECIFICATION : AWWA C301-L
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (¼") ℄
WIRE MESH—INSIDE } : REF. No A-S-X-133
OUTSIDE }
WALL THICKNESS : (3⅞")
(⅝") EXTRA COATING INCLUDED

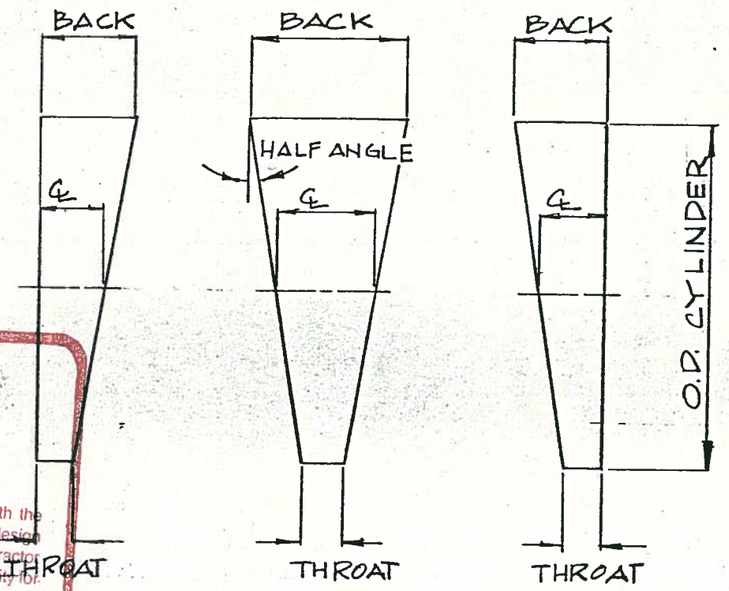
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK II

Scale: NTS		Date: 01/07/82		
Drawn by: RR	Checked by: GHL	Approved by: [signature]	Drawing No. 91-0121-26	Rev.





FULL ANGLE 21°-20'-38"
HALF ANGLE 10°-40'-19"

SHOP DRAWING REVIEW
1 ☐ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☒ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED
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BY [signature] DATE July 30/82
ASSOCIATED ENGINEERING SERVICES LTD
AESL

NOM. DIA.	O.D. CYL.	RADIUS	MB	MS	TANG.	EB	ES	BELL SEG. BACK	BELL SEG. ℄	BELL SEG. THROAT	STD SEG. BACK	STD SEG. ℄	STD SEG. THROAT	SPIGOT SEG. BACK	SPIGOT SEG. ℄	SPIGOT SEG. THROAT
36"	40½"	6'-0¼"	4'-9"	4'-9"	3'-9⅛"	11⅞"	11⅞"	28¼"	24⅞"	20⅝"	34⅞"	27¼"	19⅝"	25¼"	21⅞"	17⅝"
900	1029	1834	1447	1447	1146											

Discrepancy with that shown on dwg 91-0121-5 Rev B

TYPE V CEMENT COATING & LINING

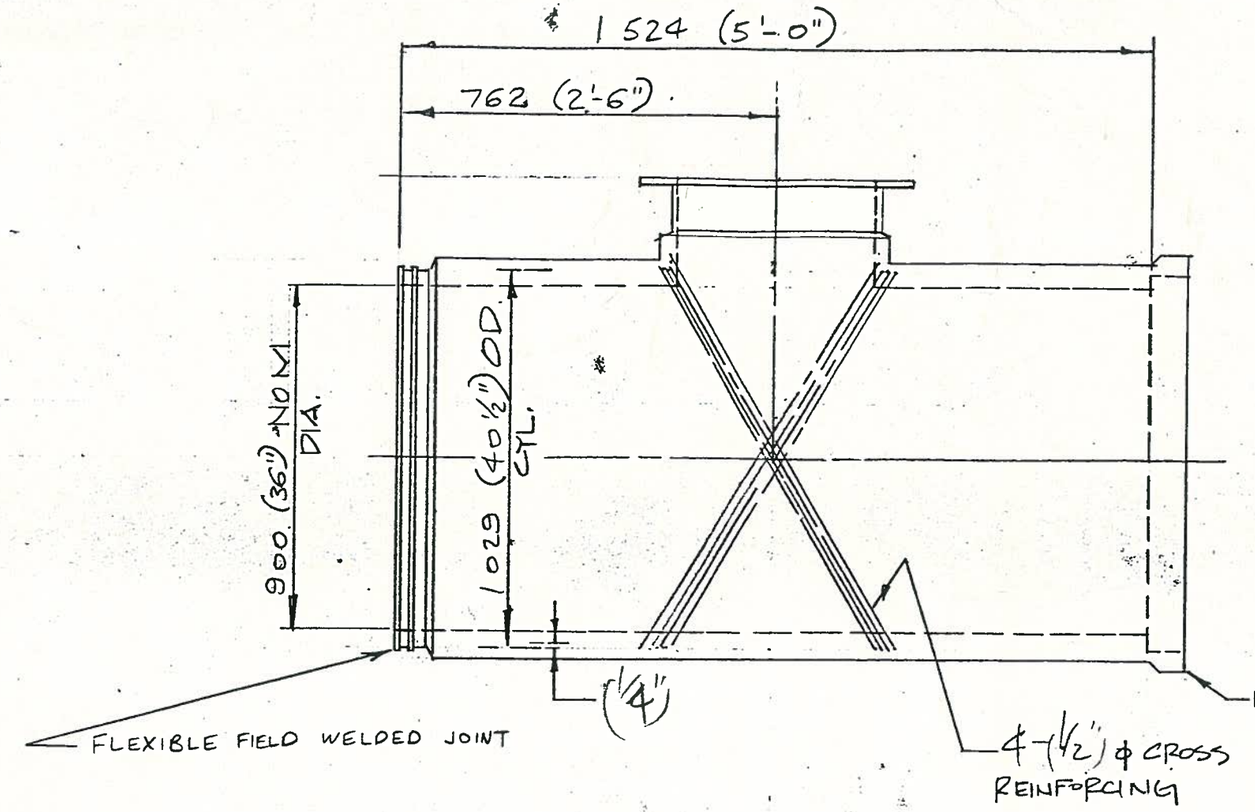
SPECIFICATION : AWWA C301-L
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (¼") ℄
WIRE MESH—INSIDE } : REF. No A-S-X-133
OUTSIDE }
WALL THICKNESS : (3⅞")
(⅝") EXTRA COATING INCLUDED

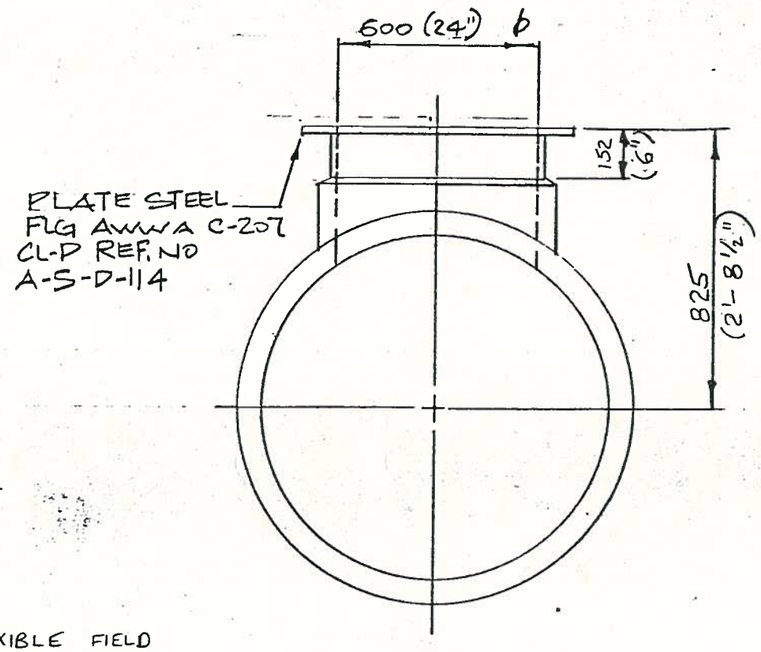
REV.	DATE:	RECORD OF CHANGE	BY:
A	JULY 23/82	GENERAL REVISION	DAB

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK 15'

Scale: N.T.S.		Date: JULY 13 1982	
Drawn by: DAB	Checked by: GHL	Approved by: GHL	Drawing No. 91-0121-27 Rev. A





VIEW AT BELL END

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY _____ DATE July 30/82

ASSOCIATED ENGINEERING SERVICES LTD

AESL

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C301(6)
TYPE	: B
~~CLASS~~/PRESSURE	: (102 PSI)
PLATE THICKNESS	: (1/4")
WIRE MESH—INSIDE	: 3 A-S-X-133
OUTSIDE	:
WALL THICKNESS	: (3⅞")

(6/8") EXTRA COATING INCLUDED.

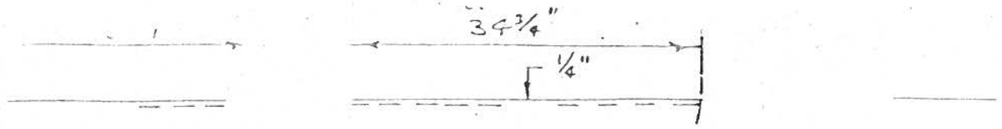
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 17

Scale: NTS		Date: 01/07/82		
Drawn by: RR	Checked by: ONL	Approved by: #	Drawing No. 91-0121-28	Rev.

FIL ANGLE 20°-22'-56" HALF ANGLE



100
L 3

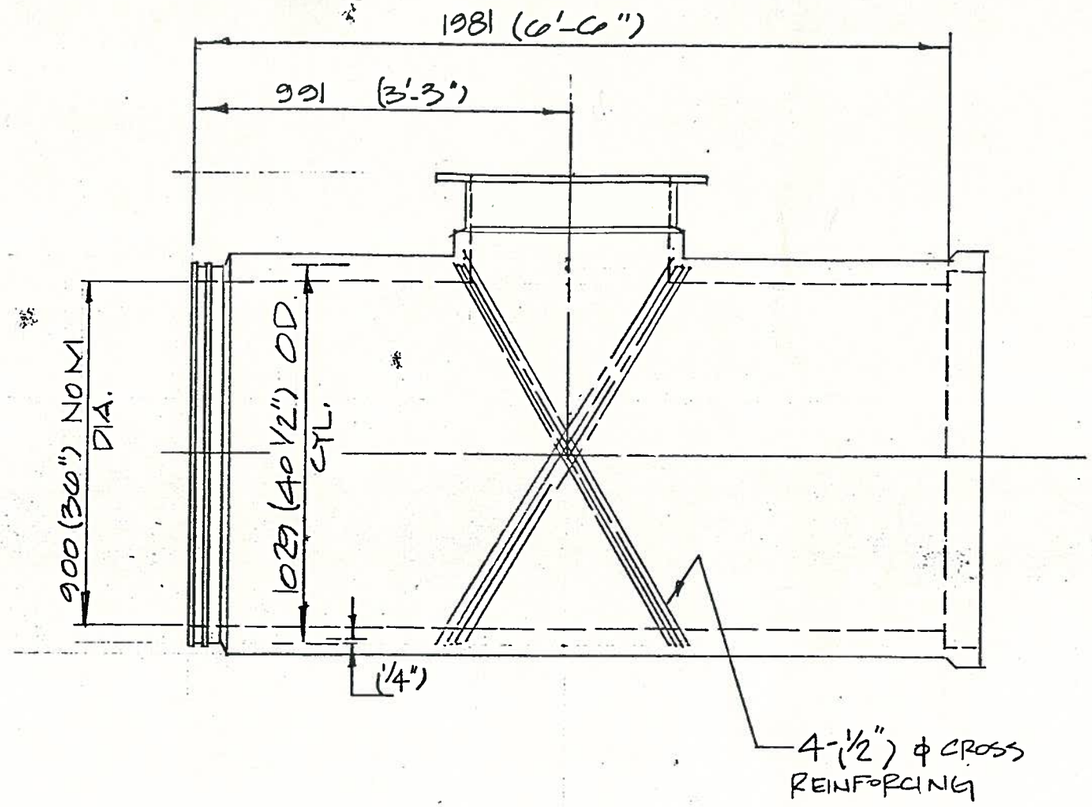
CANRON

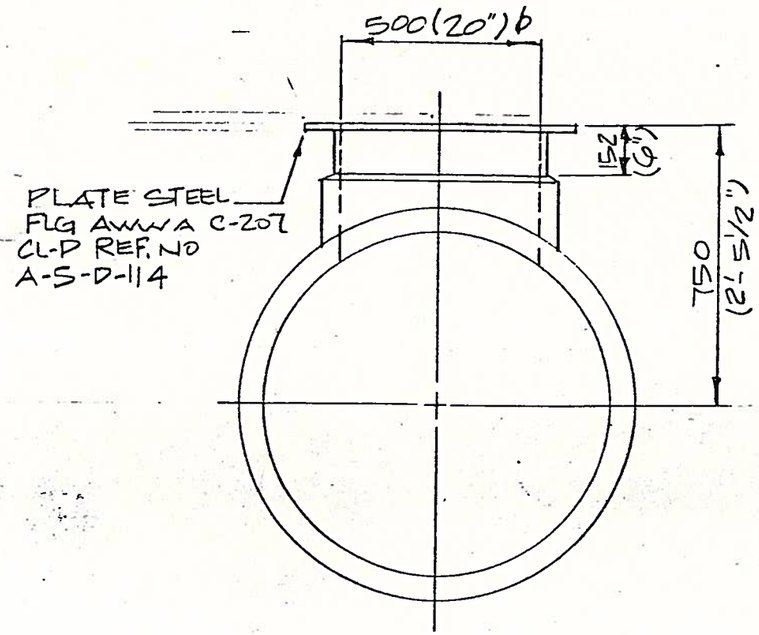
SHOP DRAWING REVIEW

1 ☑ REVIEWED; MFG. MAY PROCEED

ENGINEER

CANRON





VIEW AT BELL END

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

"This review by AESL is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that AESL approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job-site for information that pertains solely to fabrication processes or to techniques to construction and installation and for coordination of the work of all sub-trades."

BY _____ DATE July 30/82

ASSOCIATED ENGINEERING SERVICES LTD

AESL

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C301(L)
TYPE	: B
~~CLASS~~/PRESSURE	: (102 PSI)
PLATE THICKNESS	: (1/4")
WIRE MESH—INSIDE	: 3 A-S-X-133
OUTSIDE	:
WALL THICKNESS	: (3 7/8")

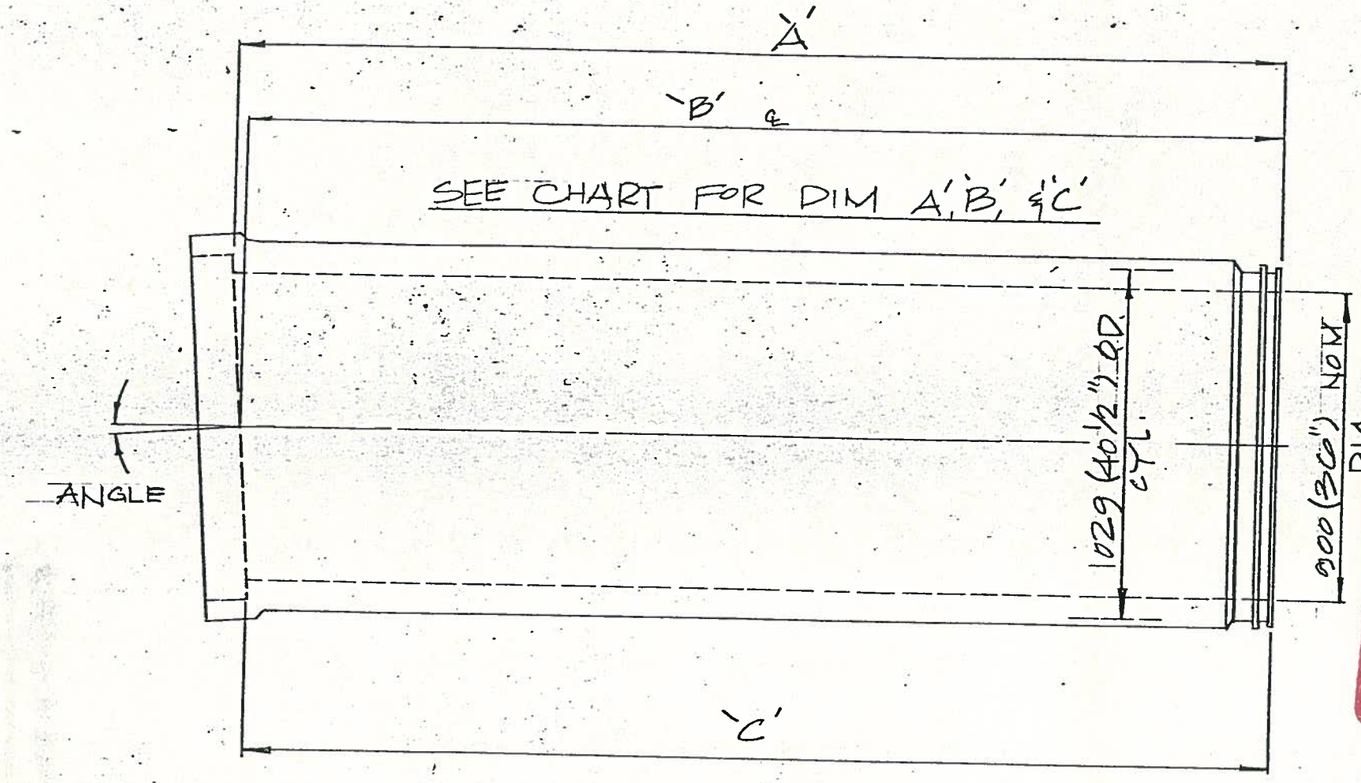
(5/8") EXTRA COATING INCLUDED

REV.	DATE:	RECORD OF CHANGE	BY:
A	JULY 13/82	DWG WAS 91-0121-17	DAB

CANRON LIMITED — PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 21

Scale: NTS			Date: 01/07/82	
Drawn by: RR	Checked by: ONL	Approved by: #	Drawing No. 91-0121-32	Rev. A



SHOP DRAWING REVIEW
1. ☐ REVIEWED: MFG. MAY PROCEED
2. ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3. ☐ REVISE AND RE-SUBMIT
4. ☐ NOT REVIEWED

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BY _____ DATE July 30/82

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

VIEW AT SPIGOT END

	ANGLE	LENGTH A'	LENGTH B'	LENGTH C'
MK 23	1°-0"	6678 (22'-10¾")	6968 (22'-10⅜")	6957 (22'-10")
MK 24	2°-0"	7422 (24'-4⅜")	7404 (24'-3½")	7386 (24'-2⅜")
MK 25	1°-0"	5718 (18'-9⅛")	5709 (18'-8¾")	5700 (18'-8⅜")
MK 28	1°-0"	1334 (4'-4½")	1322 (4'-4⅛")	1310 (4'-3¾")
MK 29	1°-0"	1848 (6'-0¾")	1837 (6'-0⅜")	1826 (6'-0")
MK 30	1°-0"	5242 (17'-2⅜")	5235 (17'-2")	5222 (17'-1⅝")

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C301 (L)
TYPE	: A
CLASS/~~PRESSURE~~	: 10
PLATE THICKNESS	: N/A
WIRE MESH—INSIDE	: N/A
OUTSIDE	:
WALL THICKNESS	: (3¾")

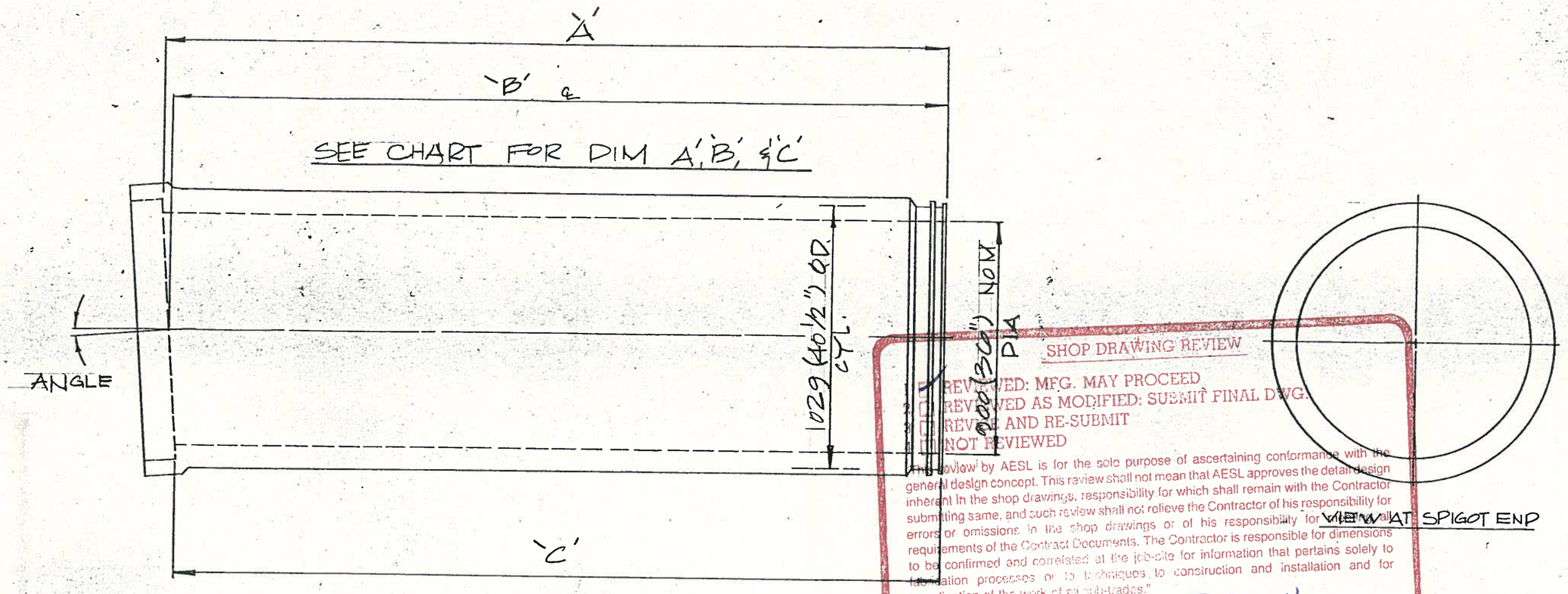
(5/8") EXTRA COATING INCLUDED.

REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 23, 24, 25, 28, 29 & 30

Scale: NTS		Date: 01\07\82		
Drawn by: RR	Checked by: GHL	Approved by:	Drawing No. 91-0121-33	Rev.



	ANGLE	LENGTH 'A'	'B'	'C'
MK 31	1°-0'	3927 (12'-10⅝")	3917 (12'-10¼")	3907 (12'-9⅞")
MK 33	1°-0"	7414 (24'-3⅞")	7404 (24'-3½")	7394 (24'-3⅛")
MK 34	1°-0"	6061 (19'-10⅝")	6050 (19'-10¼")	6039 (19'-9⅞")
MK 35	2°-30"	7426 (24'-4⅜")	7404 (24'-3½")	7382 (24'-2⅝")
MK 36	1°-0'	3331 (10'-11⅛")	3322 (10'-10¾")	3311 (10'-10⅜")
MK 37	1°-0"	1934 (6'-4⅛")	1924 (6'-3¾"	1914 (6'-3⅜")

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C301 (-)
TYPE	: A
CLASS/~~PRESSURE~~	: 10
PLATE THICKNESS	: N/A
WIRE MESH—INSIDE	: N/A
OUTSIDE	:
WALL THICKNESS	: (3¾")

(5/8") EXTRA COATING INCLUDED

SHOP DRAWING REVIEW

☐ REVIEWED: MFG. MAY PROCEED
☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
☐ REVISE AND RE-SUBMIT
☐ NOT REVIEWED

Review by AESL is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that AESL approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job-site for information that pertains solely to fabrication processes or to techniques to construction and installation and for coordination of the work of all sub-trades."

BY ASSOCIATED ENGINEERING SERVICES

DATE July 30/82

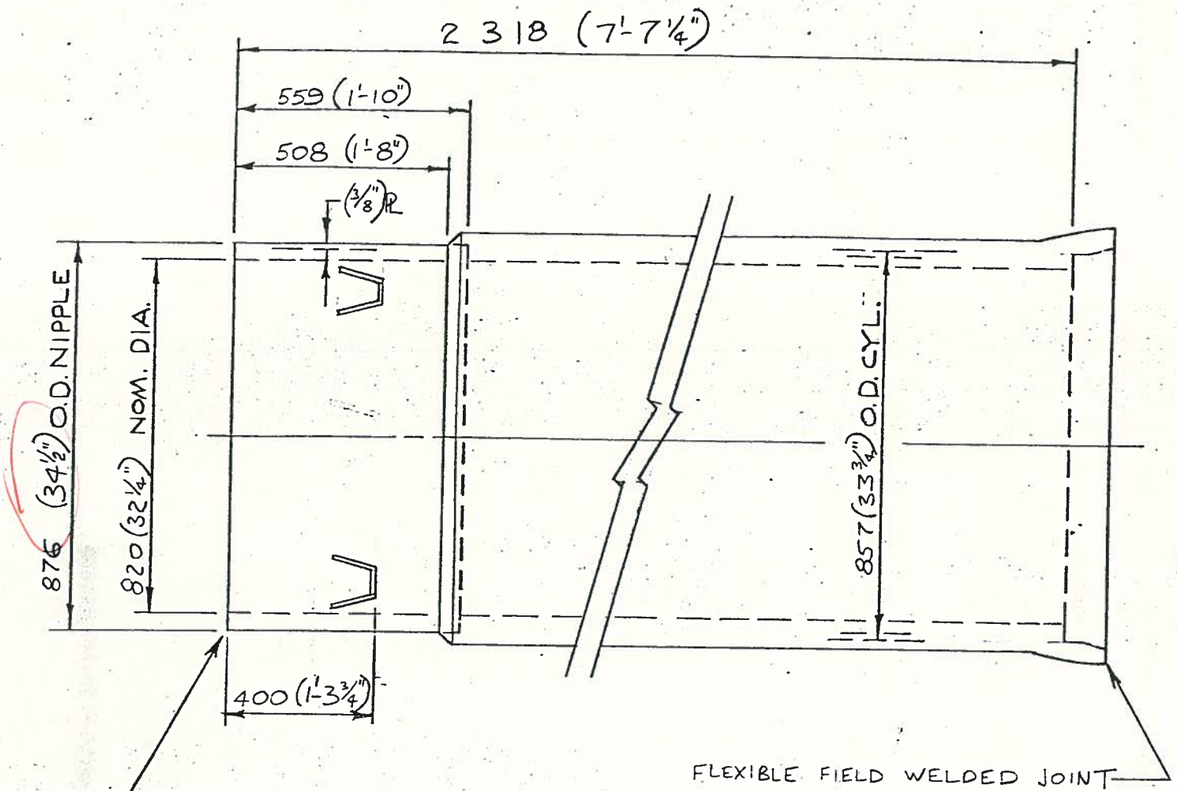
AESL

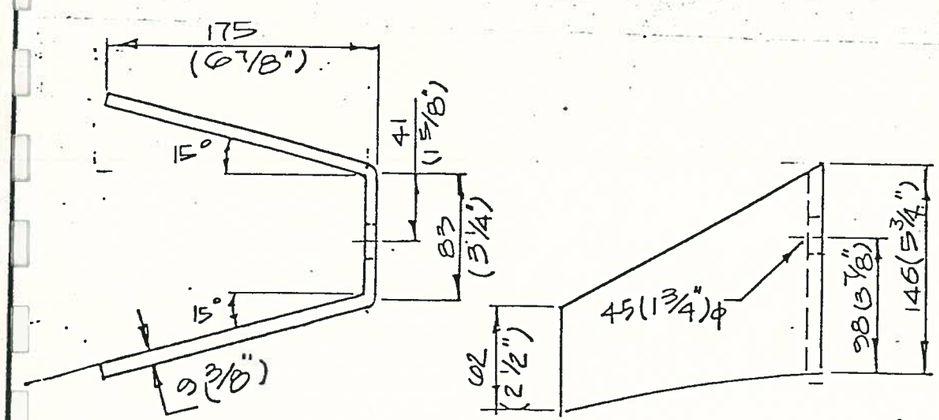
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 31, 33, 34, 35, 36 & 37

Scale: NTS		Date: 01/07/82		
Drawn by: RR	Checked by: DHL	Approved by: [illegible]	Drawing No. 91-0121-34	Rev.





DETAIL OF LUG

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C303
TYPE	: A
CLASS/~~PRESSURE~~	: 100
PLATE THICKNESS	: —
WIRE MESH—INSIDE	: —
OUTSIDE	: —
WALL THICKNESS	: (2⅜")

(2⅜") TOTAL WHICH INCLUDES (⅝") EXTRA COATING OVER STD. COATING

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED ★
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

"This review by AESL is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that AESL approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job-site for information that pertains solely to fabrication processes or to techniques to construction and installation and for coordination of the work of all sub-trades."

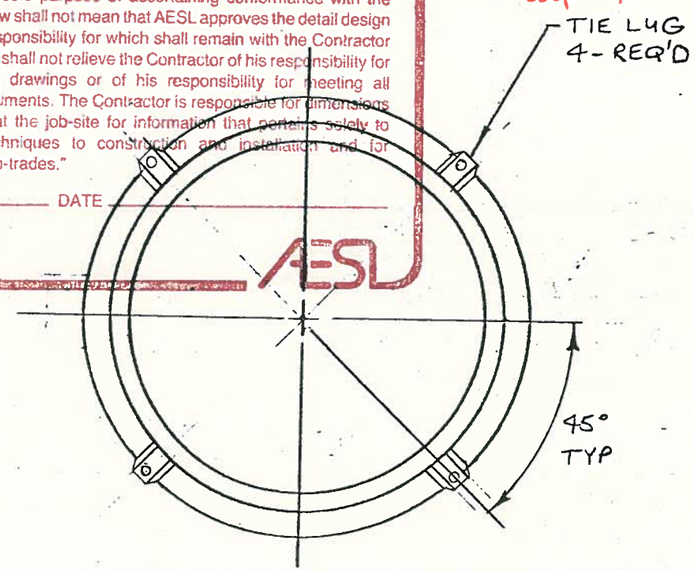
BY _____ DATE _____

ASSOCIATED ENGINEERING SERVICES LTD

AESL

★ see the notes in Red Below.

Subject to 34½" OD meeting reqd O.D for coupling.



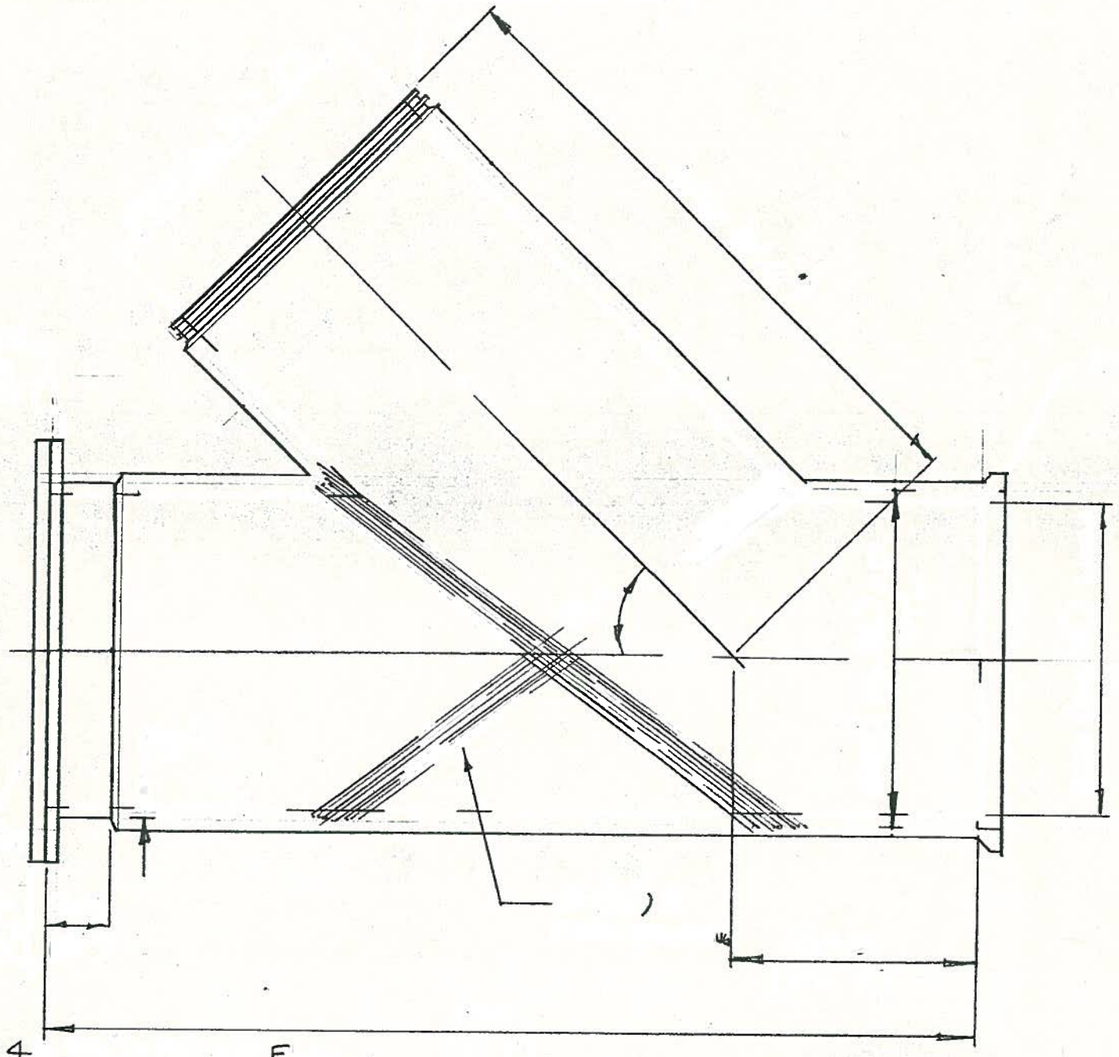
VIEW AT END

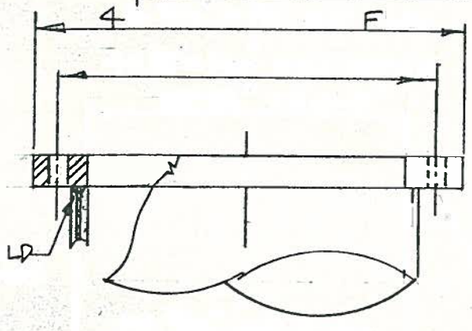
REV.	DATE:	RECORD OF CHANGE	BY:
A		added 2 tie lugs	

CANRON LIMITED PIPE DIVISION

COMOX - STRATHCONA S-7
DETAIL OF MK. No. 39

Scale: N.T.S.		Date: JULY 20 1982		
Drawn by: DAB	Checked by:	Approved by:	Drawing No. 91-0121-36	Rev. A





TYPE V CEMENT COATING & LINING

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED. SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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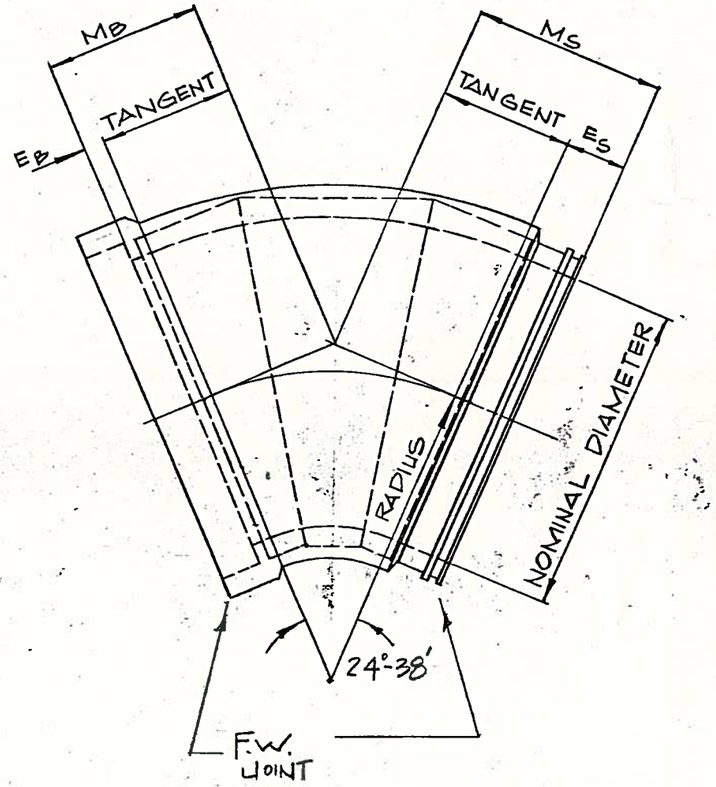
BY [signature] DATE Aug 10/92

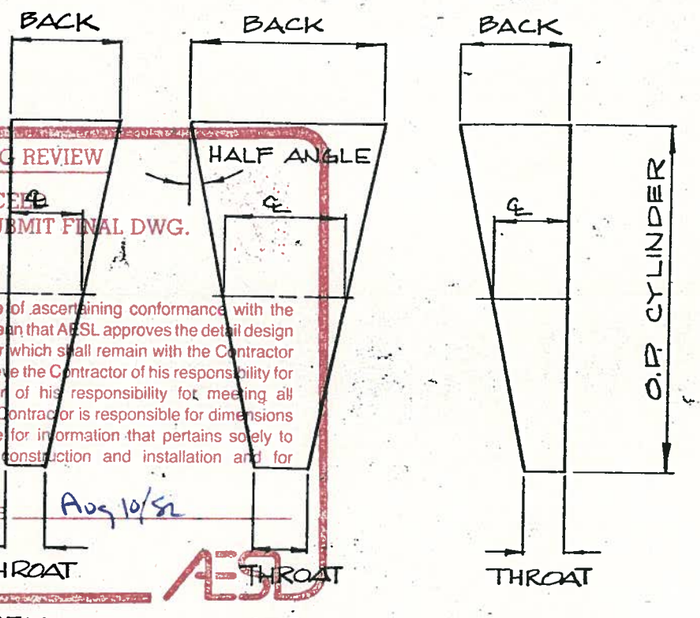
ASSOCIATED ENGINEERING SERVICES LTD

REV.	DATE:		BY:

CANRON

		LY	
	Checked by: UH	: 1	Drawing No. 91-0121-37





SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY _____ DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD

AESL

FULL ANGLE = 12°-09'-00"
HALF ANGLE = 6°-04'-30"

NOM. DIA	OD CYL.	RADIUS	MB	MS	TANG.	EB	ES	FOR CANRON USE ONLY								
								BELL SEGMENT			STD SEG.			SPIGOT SEGMENT		
								BACK	℄	THROAT	BACK	℄	THROAT	BACK	℄	THROAT
820 (32 1/4")	851 3/4 (33 3/4")	3200 (10'-8 1/2")	1013 (3'-3 7/8")	1013 (3'-3 7/8")	712 (2'-4")	301 (11 7/8")	301 (11 7/8")	26 5/16	24 1/2	22 1/16"	31	27 3/8"	23 3/4	23 5/16"	21 1/2"	19 11/16

TYPE V CEMENT COATING & LINING

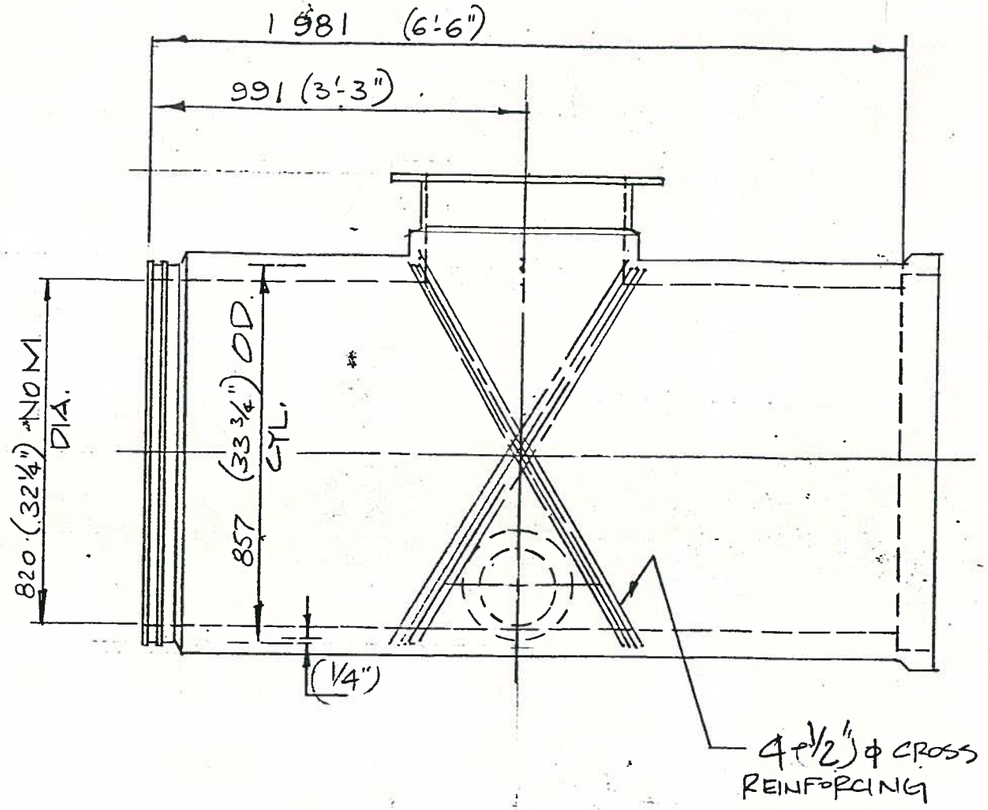
SPECIFICATION : AWWA C303
TYPE : B
~~CLASS~~/PRESSURE : 102 PSI
PLATE THICKNESS : (3/16")
WIRE MESH—INSIDE : A-5-X-133
OUTSIDE : A-5-X-133
WALL THICKNESS : 79 (3 1/8")
(5/8") EXTRA COATING INCLUDED

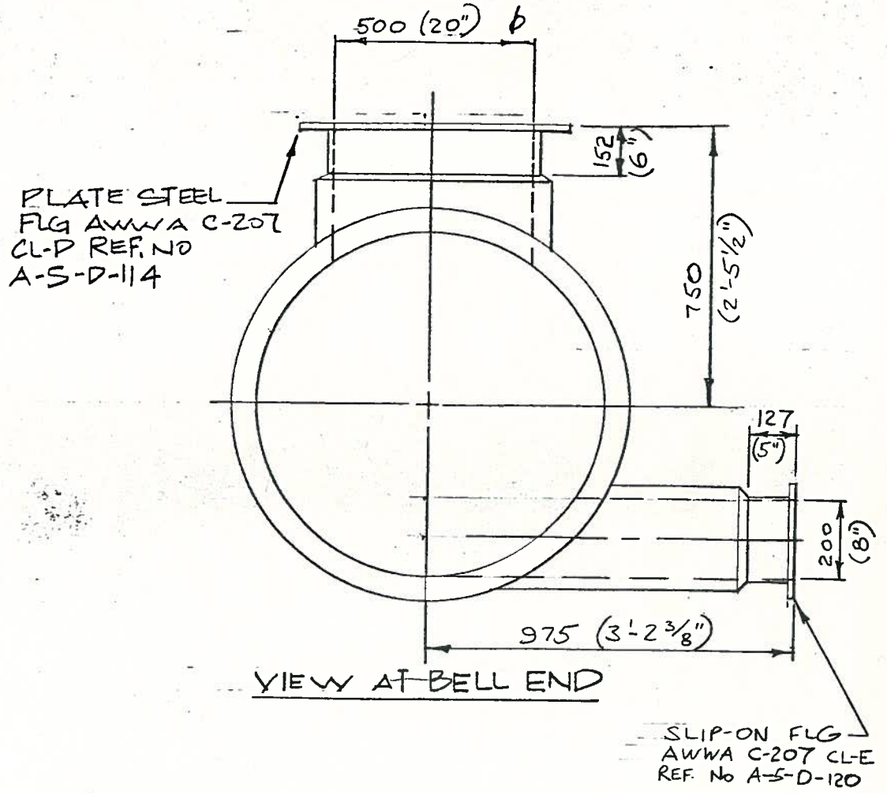
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 43

Scale: NTS		Date: 01/07/82		
Drawn by: RR	Checked by: [illegible]	Approved by: [illegible]	Drawing No 91-0121-38	Rev.





SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY _____ DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD.

TYPE V CEMENT COATING & LINING

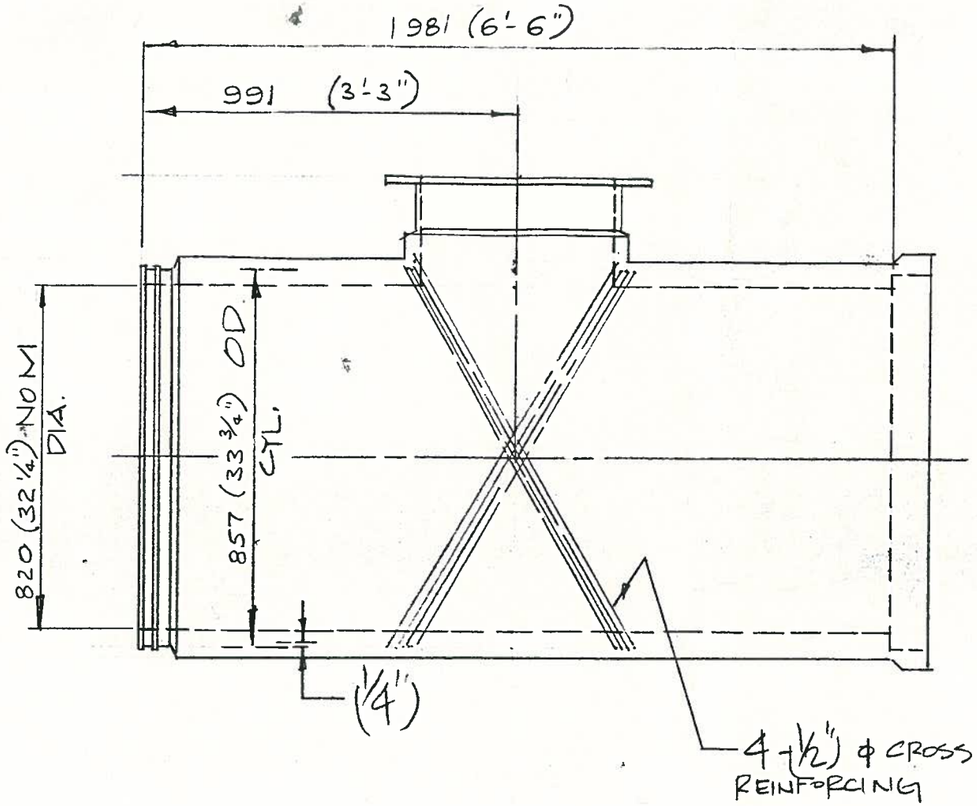
SPECIFICATION : AWWA C303
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (¼")
WIRE MESH—INSIDE : 3 A-S-X-133
OUTSIDE :
WALL THICKNESS : (3⅛")
(⅝") EXTRA COATING INCLUDED

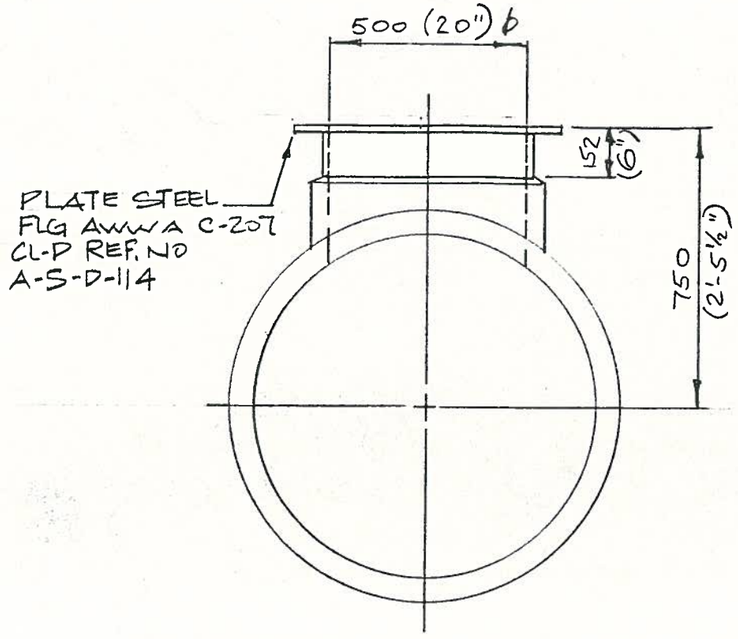
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 48.

Scale: NTS			Date: 01/07/82	
Drawn by: RR	Checked by: GHL	Approved by: #	Drawing No. 91-0121-39	Rev.





VIEW AT BELL END

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY _____ DATE Aug 30/82

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C303
TYPE	: B
~~CLASS~~/PRESSURE	: (102 PSI)
PLATE THICKNESS	: (1/4")
WIRE MESH—INSIDE	: 3 A-5-X-133
OUTSIDE	:
WALL THICKNESS	: (3 1/8")

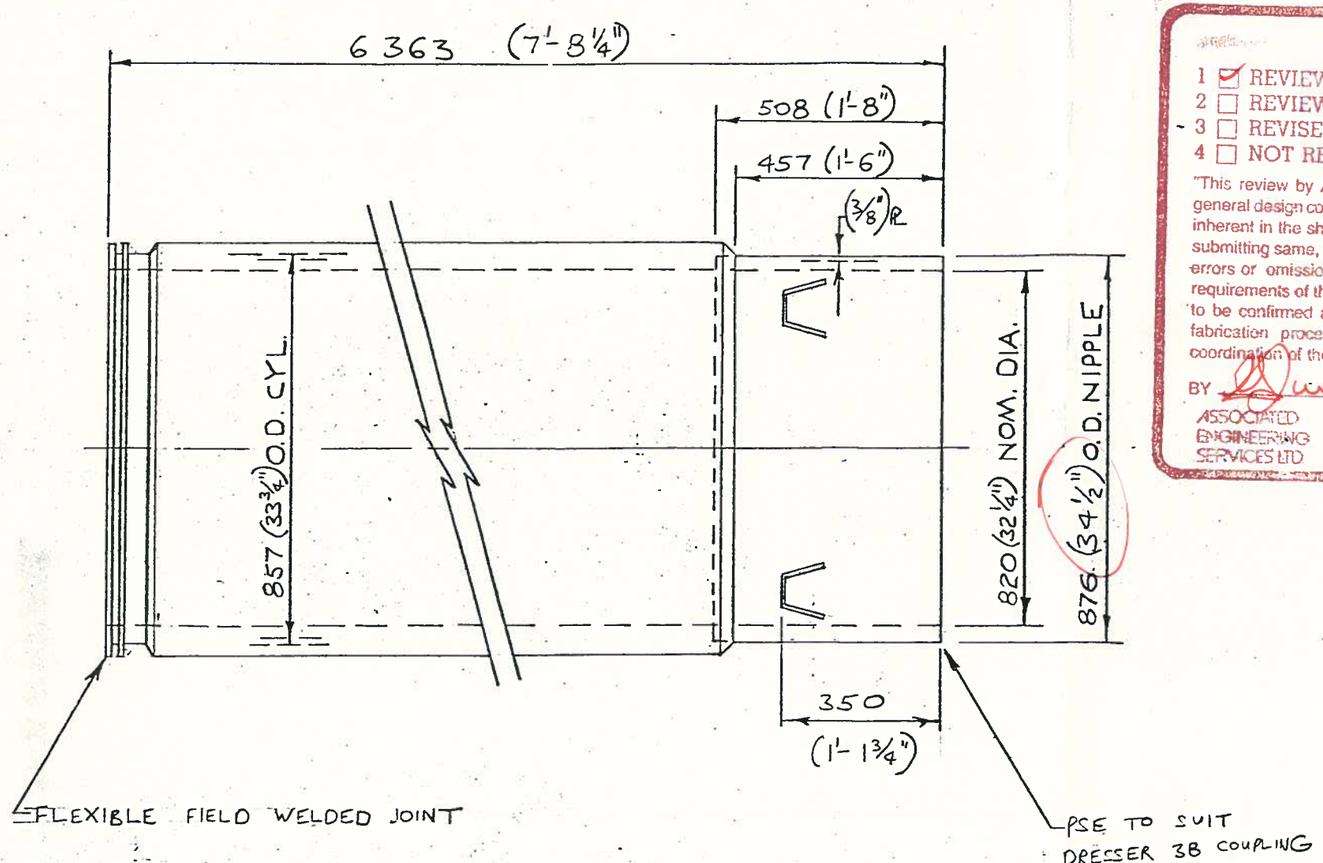
(5/8") EXTRA COATING INCLUDED

REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 55

Scale: NTS		Date: 01/07/82		
Drawn by: RR	Checked by: GHL	Approved by: #	Drawing No. 91-012-40	Rev.



SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED ★
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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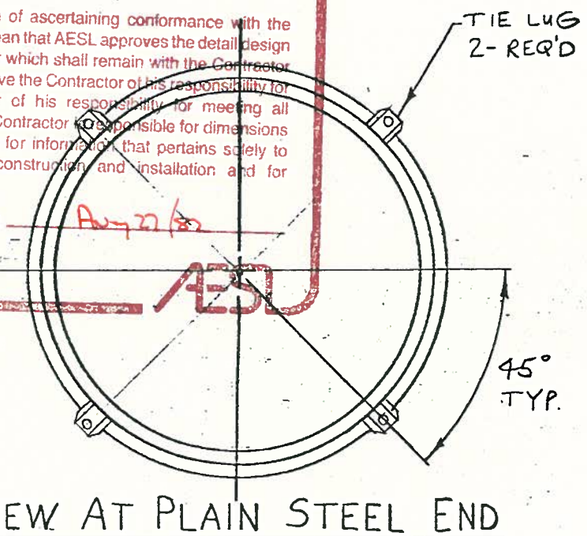
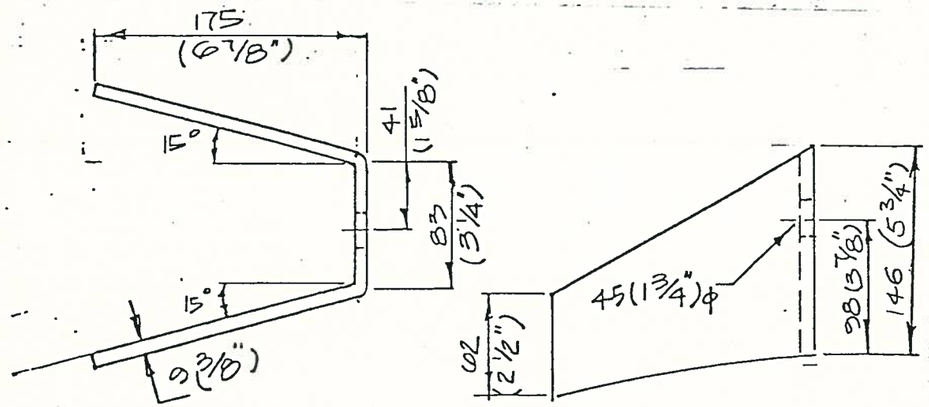
BY [signature] DATE Aug 22/82

ASSOCIATED ENGINEERING SERVICES LTD

★ See notes in Red below.
subject to 34½" OD meeting reqd OD of coupling.



VIEW AT PLAIN STEEL END



DETAIL OF LUG

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C303
TYPE	: A
CLASS/~~PRESSURE~~	: 100
PLATE THICKNESS	: ——
WIRE MESH—INSIDE	: ——
OUTSIDE	: ——
WALL THICKNESS	: (2⅜")

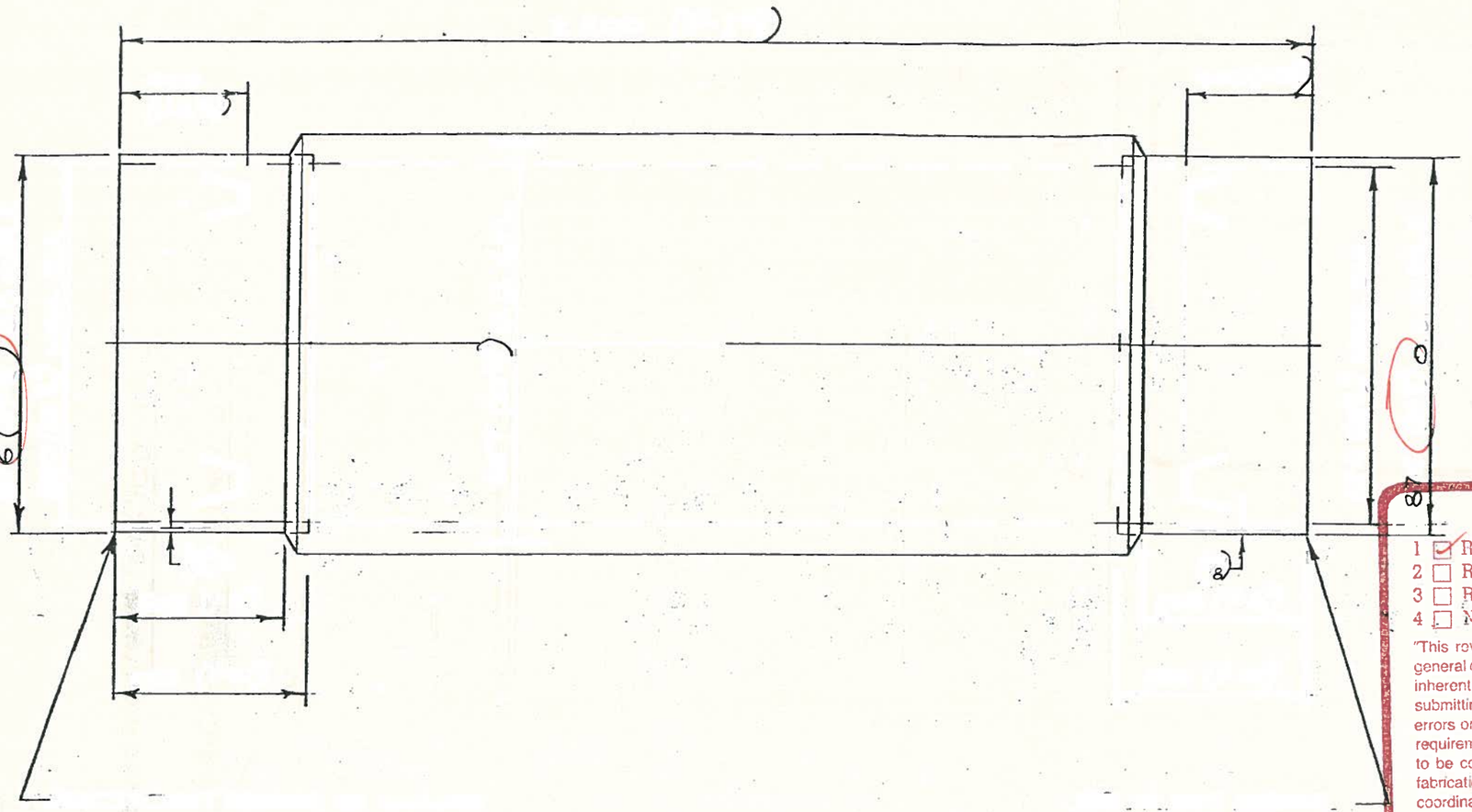
(2⅜") TOTAL WHICH INCLUDES (⅝") EXTRA COATING OVER STD. COATING.

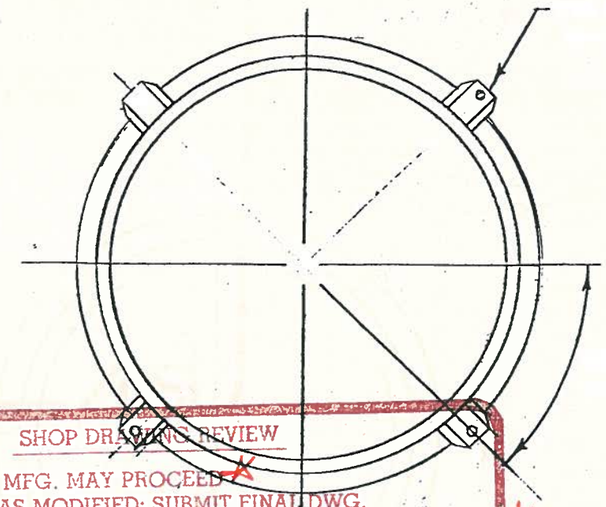
REV.	DATE:	RECORD OF CHANGE	BY:
A		added 2 tie lugs	

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK. No. 60

Scale: N.T.S.		Date: JULY 19 1982		
Drawn by: DAB	Checked by:	Approved by:	Drawing No. 91-0121-41	Rev. A





SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED *
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

VIEW AT PIPE

"This review by AESL is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that AESL approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job-site for information that pertains solely to fabrication processes or to techniques to construction and installation and for coordination of the work of all sub-trades."

BY [signature] DATE Aug 27/22

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

* subject to 34 ½" O.D meeting required O.D for coupling

LINING

REV.	DATE:		BY:
A	JULY 22		DAB

CANRON

PIPE

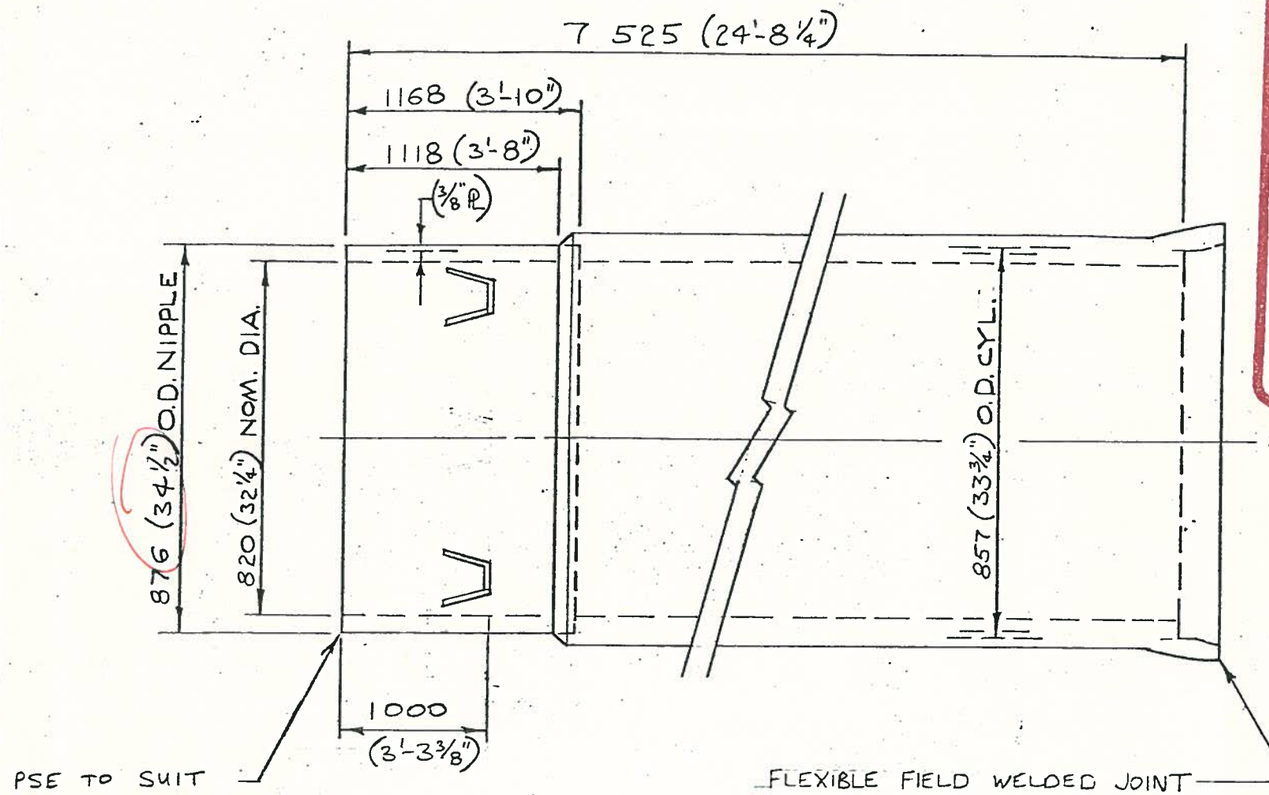
TH ONA

MK. No.

Date: JULY

Approved by: #

Rev. A



SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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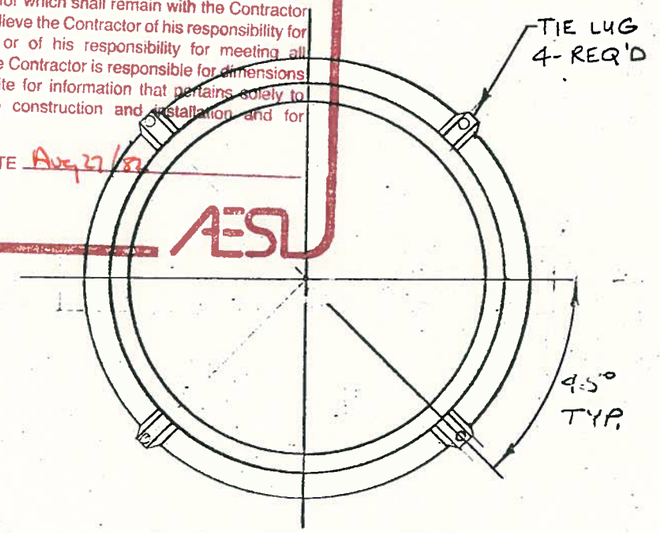
BY _____ DATE Aug 27/82

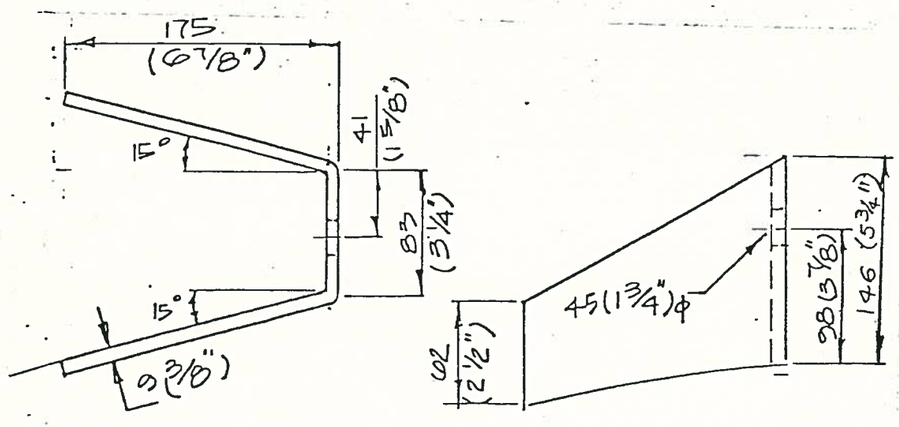
ASSOCIATED ENGINEERING SERVICES LTD.

AESL

★ see notes below.
★ Subject to 34½" O.D. mating required O.D. & coupling for ED.



VIEW AT END



DETAIL OF LUG

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C303
TYPE	: A
CLASS/~~PRESSURE~~	: 100
PLATE THICKNESS	: —
WIRE MESH—INSIDE	: —
OUTSIDE	: —
WALL THICKNESS	: (2⅜")

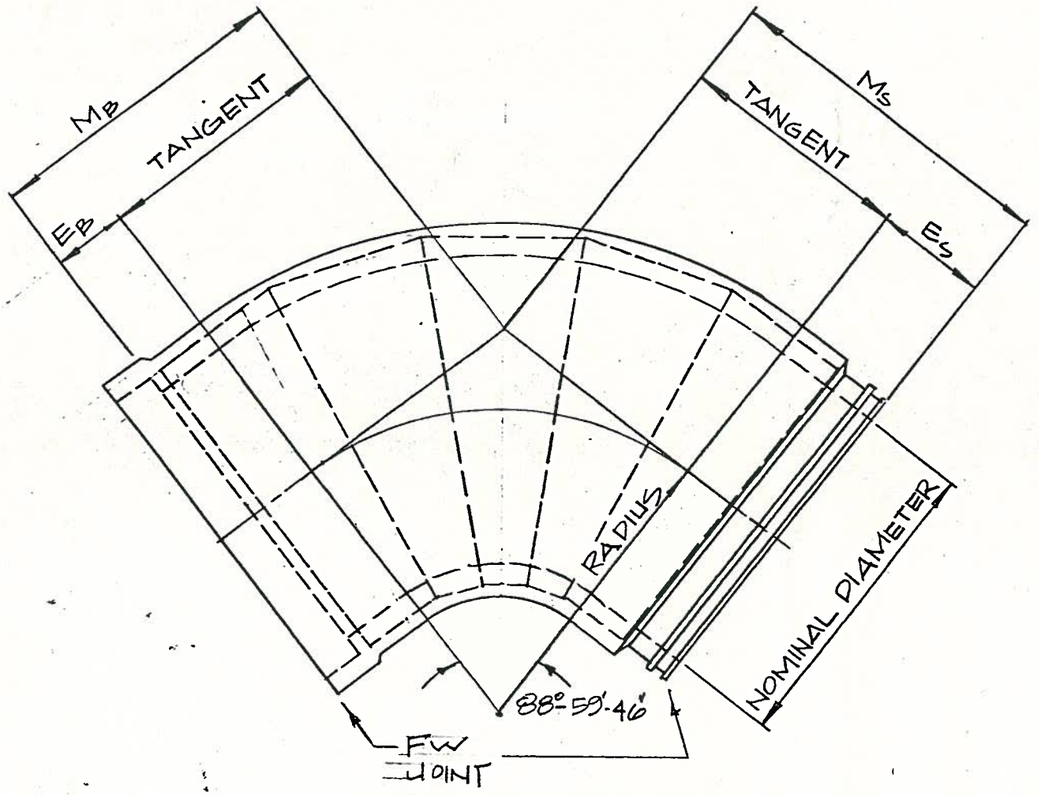
(2⅜") TOTAL WHICH INCLUDES (⅝") EXTRA COATING OVER STD COATING.

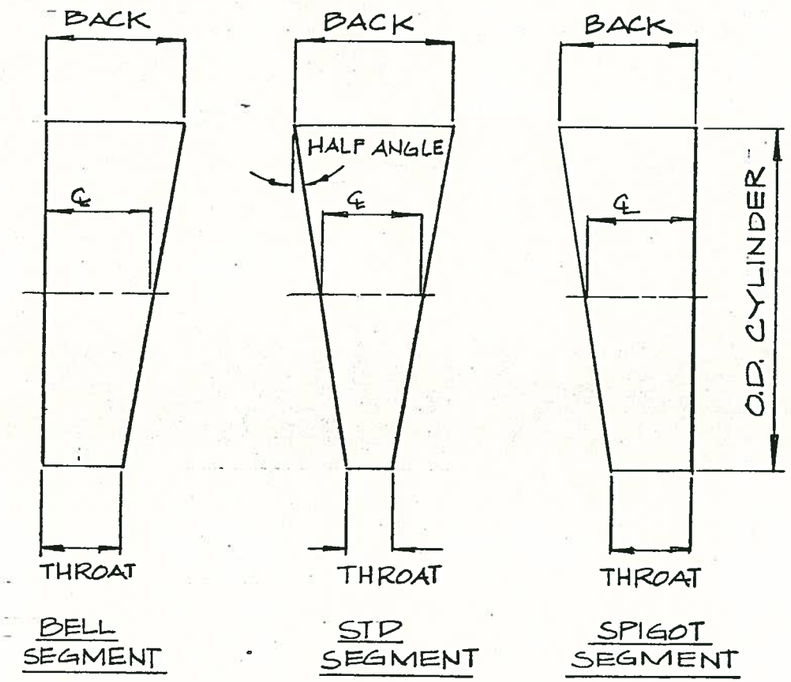
REV.	DATE:	RECORD OF CHANGE	BY:
A		2 tie lugs added.	

CANRON LIMITED PIPE DIVISION

COMOX- STRATHCONA S-7
DETAIL OF MK. No. 62

Scale: N.T.S.		Date: JULY 19 1982		
Drawn by: JAB	Checked by:	Approved by:	Drawing No. 91-0121-43	Rev. A





FULL ANGLE = 22°-14'-56
HALF ANGLE = 11°-07'-28"

NOM DIA.	O.D CYL.	RADIUS	M_B	M_S	TANG.	E_B	E_S	FOR CANRON USE ONLY								
								BELL SEG.			STD SEG.			SPIGOT SEG		
								BACK	℄	THROAT	BACK	℄	THROAT	BACK	℄	THROAT
820 (32 1/4")	857 (33 3/4")	1750 (5'-8 7/8")	2020 (6'-7 1/2")	2020 (6'-7 1/2")	1720 (5'-7 5/8")	300 (11 7/8")	300 (11 7/8")	27 11/16"	24 3/8"	21 1/16"	33 11/16"	27 1/16"	20 7/16"	24 11/16"	21 3/8"	18 1/16"

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

"This review by AESL is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that AESL approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job-site for information that pertains solely to fabrication processes or to techniques to construction and installation and for coordination of the work of all sub-trades."

BY D Dunsmore DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C303
TYPE	: B
~~CLASS~~/PRESSURE	: 102 PSI
PLATE THICKNESS	: (3/16")
WIRE MESH—INSIDE	: A-5-x-133
OUTSIDE	: A-5-x-133
WALL THICKNESS	: 79 (3 1/8")

(5/8") EXTRA COATING INCLUDED

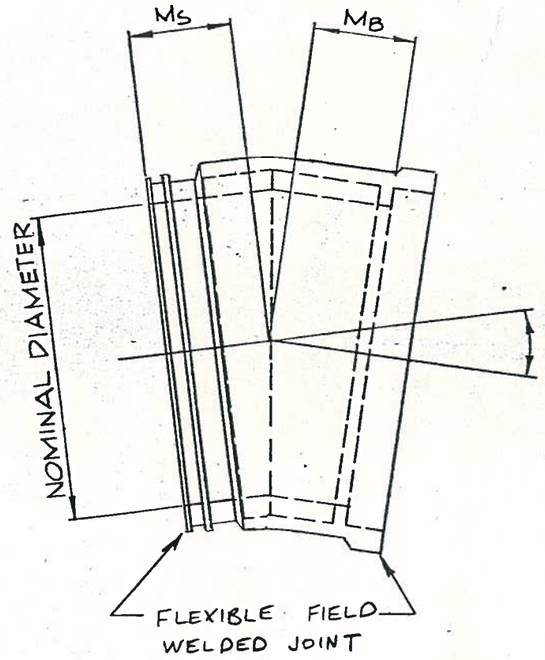
REV.	DATE:	RECORD OF CHANGE	BY:

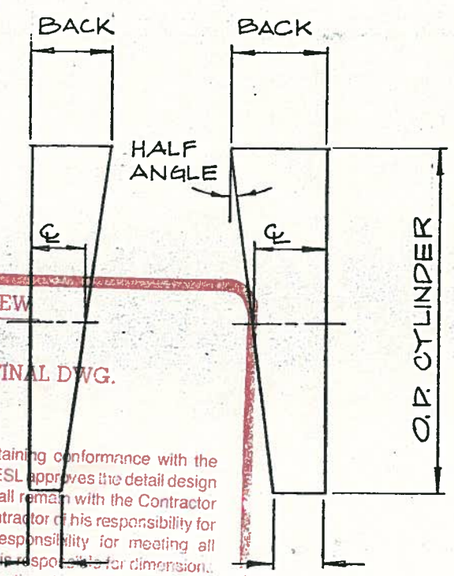
CANRON LIMITED PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 63

Scale: NTS		Date: 01/07/82		
Drawn by: RR	Checked by: DHL	Approved by: #	Drawing No. 91-0121-44	Rev.

FULL ANGLE 6°-19'-21"
HALF ANGLE 3°-09'-40"





SHOP DRAWING REVIEW
1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY _____ DATE Aug 16/82
ASSOCIATED ENGINEERING SERVICES LTD

TANG.	RADIUS	NOM. DIA.	O.D. CYL.	Ms	MB	SPIGOT SEG. BACK	SPIGOT SEG. ℄	SPIGOT SEG. THROAT	BELL SEG. BACK	BELL SEG. ℄	BELL SEG. THROAT
11 15/16"	18'-0 1/4"	32 1/4"	33 3/4"	1'-11 3/4"	1'-11 3/4"	20 11/16"	19 3/4"	18 13/16"	23 11/16"	22 3/4"	21 13/16"
303	5492	820	857	604	604						

TYPE V CEMENT COATING & LINING

SPECIFICATION : AWWA C303
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (3/16" ℄
WIRE MESH—INSIDE } : REF. No. A-S-X-133
OUTSIDE }
WALL THICKNESS : (3 1/8")
(5/8") EXTRA COATING INCLUDED

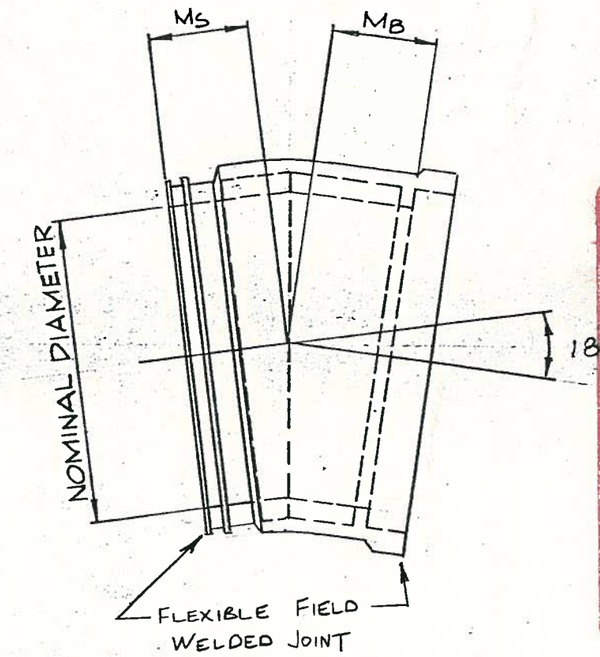
REV.	DATE:	RECORD OF CHANGE	BY:

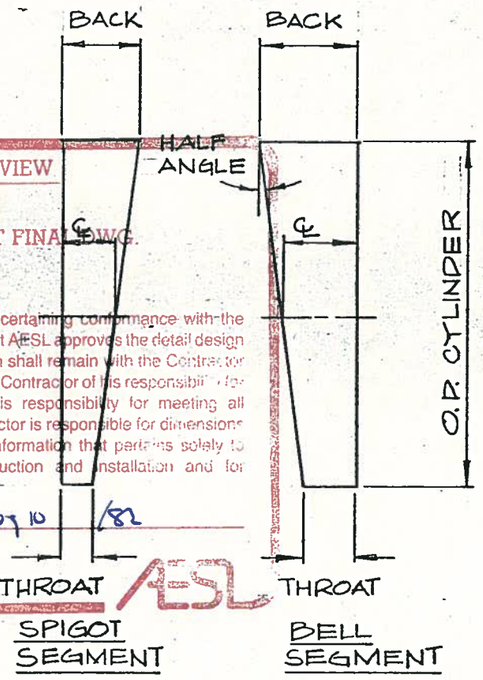
CANRON LIMITED PIPE DIVISION

COMOX - STRATHCONA S-7
DETAIL OF MK. No. 65

Scale: N.T.S.		Date: JULY 14 1982		
Drawn by: DAB	Checked by: AHH	Approved by: AHH	Drawing No. 91-0121-45	Rev.

FULL ANGLE 18°-01'-48"
HALF ANGLE 9°-00'-54"





SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY [signature] DATE Aug 10 /82

ASSOCIATED ENGINEERING SERVICES LTD

AESL

TANG	RADIUS	NOM. DIA.	O.D. CYL.	Ms	MB	SPIGOT SEG.			BELL SEG.		
						BACK	℄	THROAT	BACK	℄	THROAT
11 15/16"	6'-3 1/4"	32 1/4"	33 3/4"	1'-11 3/4"	1'-11 3/4"	22 7/16"	19 3/4"	17 1/16"	25 7/16"	22 3/4"	20 1/16"
303	1912	820	857	604	604						

TYPE V CEMENT COATING & LINING

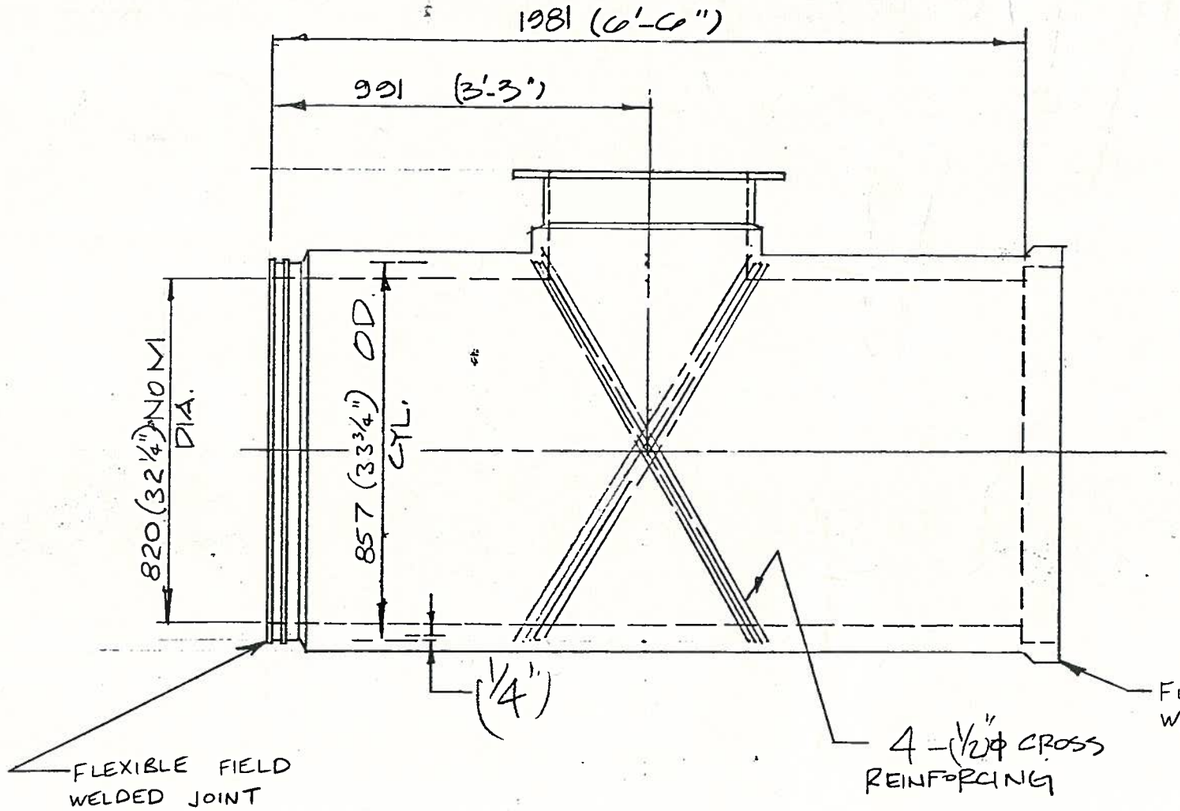
SPECIFICATION : AWWA C303
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (3/16") ℞
WIRE MESH—INSIDE } REF. No. A-5-X-133
OUTSIDE }
WALL THICKNESS : (3 1/8")
(5/8") EXTRA COATING INCLUDED

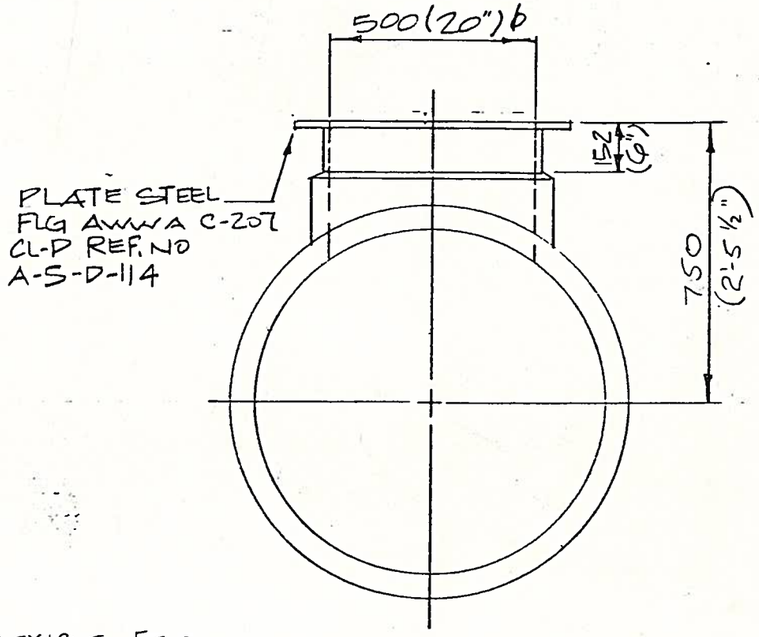
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK. No. 68

Scale: N.T.S.		Date: JULY 14 1982		
Drawn by: DAB	Checked by: AIN	Approved by: AIN.	Drawing No. 91-012L-46	Rev.





SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY _____ DATE Aug 16/82

ASSOCIATED ENGINEERING SERVICES LTD.

AESL

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C303
TYPE	: B
~~CLASS~~/PRESSURE	: 102 PSI
PLATE THICKNESS	: (¼")
WIRE MESH—INSIDE	: 3 A-S-X-133
OUTSIDE	:
WALL THICKNESS	: (3⅛")

(⅝") EXTRA COATING INCLUDED

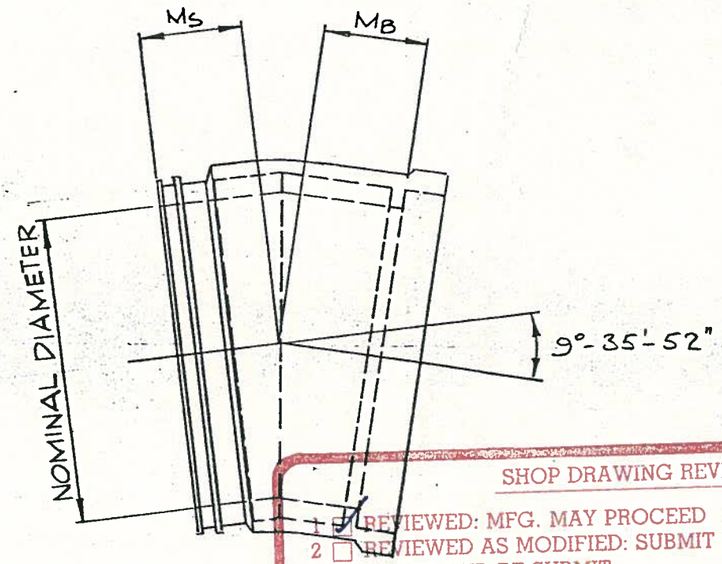
REV.	DATE:	RECORD OF CHANGE	BY:

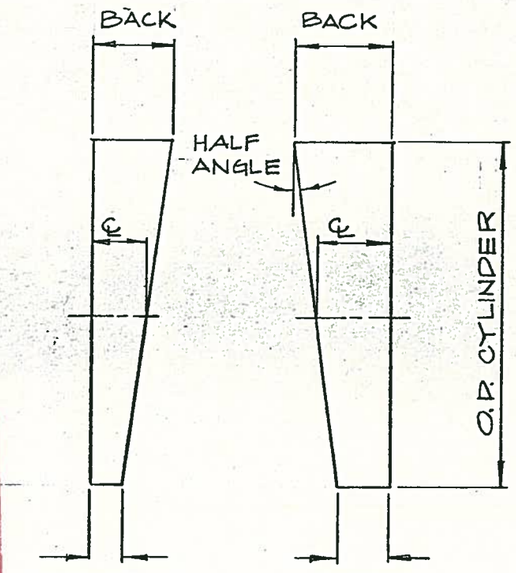
CANRON LIMITED — PIPE DIVISION

COMOX STRATHCONA S-7
DETAIL OF MK 70

Scale: NTS		Date: 01/07/82		
Drawn by: RR	Checked by: GHL	Approved by: #	Drawing No. 91-0121-47	Rev.

FULL ANGLE 9°-35'-52"
HALF ANGLE 4°-47'-56"





TANG.	RADIUS	NOM. DIA.	O.D. CYL.	Ms	MB	SPIGOT SEG.			BELL SEG.		
						BACK	℄	THROAT	BACK	℄	THROAT
11 15/16"	11'-10 1/4"	32 1/4"	33 3/4"	1'-11 3/4"	1'-11 3/4"	21 3/16"	19 3/4"	18 5/16"	24 3/16"	22 3/4"	21 5/16"
303	3613	820	857	604	604						

SHOP DRAWING REVIEW

1 ☒ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY [signature] DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD

TYPE V CEMENT COATING & LINING

SPECIFICATION : AWWA C303
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (3/16") ℄
WIRE MESH—INSIDE } : REF. No. A-5-X-133
OUTSIDE }
WALL THICKNESS : (3/8")
(5/8") EXTRA COATING INCLUDED

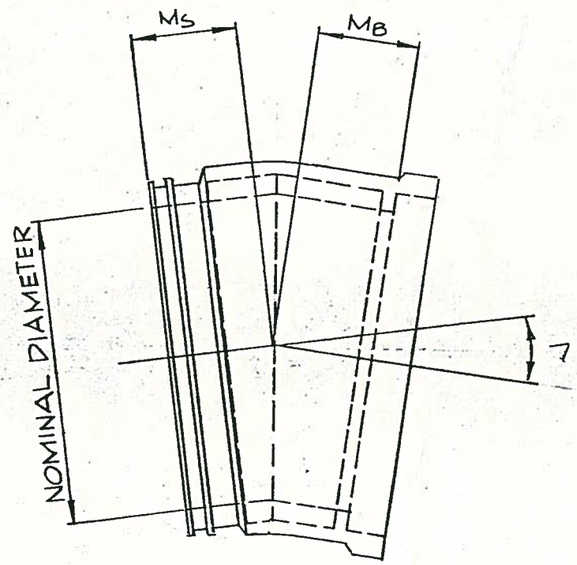
REV.	DATE:	RECORD OF CHANGE	BY:

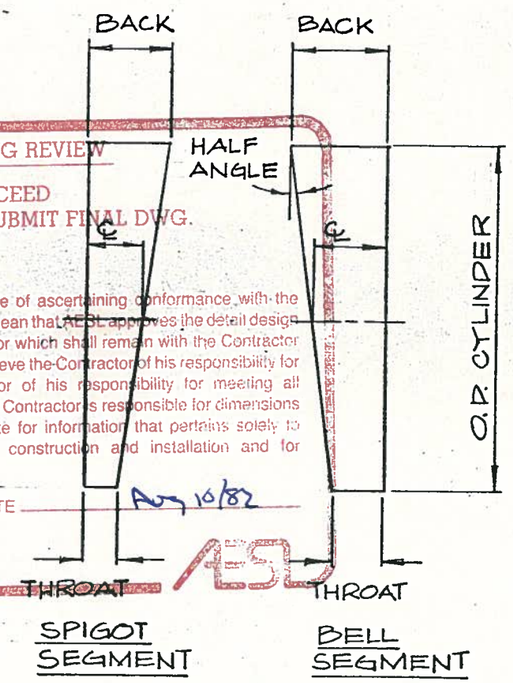
CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK. No. 74

Scale: N.T.S.		Date: JULY 14 1982		
Drawn by: JAB	Checked by: AM	Approved by: AM.	Drawing No. 91-0121-48	Rev.

FULL ANGLE 7° 02' 29"
HALF ANGLE 3° 31' 14"





SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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BY [signature] DATE Aug 10/82

ASSOCIATED ENGINEERING SERVICES LTD

TANG.	RADIUS	NOM. DIA.	O.D. CYL.	Ms	MB	SPIGOT SEG.			BELL SEG.		
						BACK	℄	THROAT	BACK	℄	THROAT
11 15/16"	16'-2 1/8"	32 1/4"	33 3/4"	1'-11 3/4"	1'-11 3/4"	20 13/16"	19 3/4"	18 11/16"	23 13/16"	22 3/4"	21 11/16"
303	4930	820	857	604	604						

TYPE V CEMENT COATING & LINING

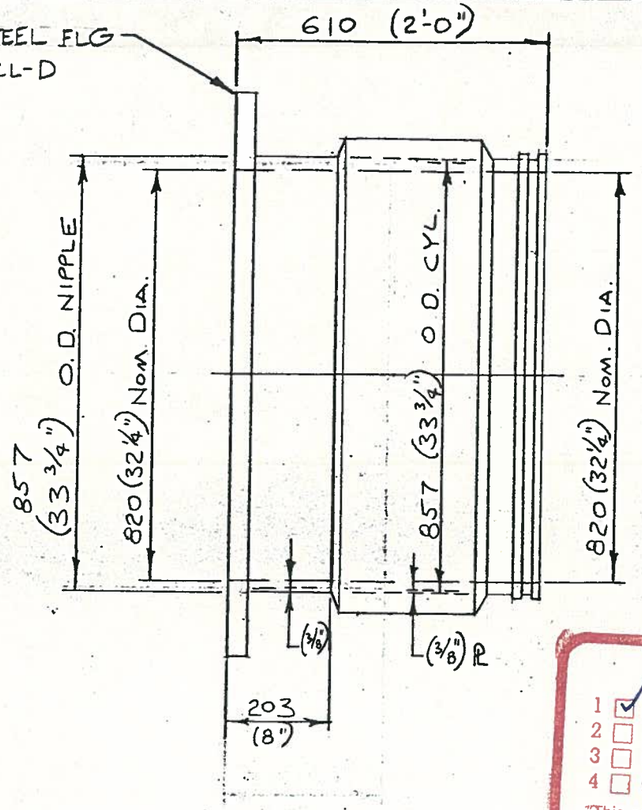
SPECIFICATION : AWWA C303
TYPE : B
~~CLASS~~/PRESSURE : (102 PSI)
PLATE THICKNESS : (3/16") ℄
WIRE MESH—INSIDE } : REF. No A-5-X-133
OUTSIDE }
WALL THICKNESS : (3 1/8")
(5/8") EXTRA COATING INCLUDED

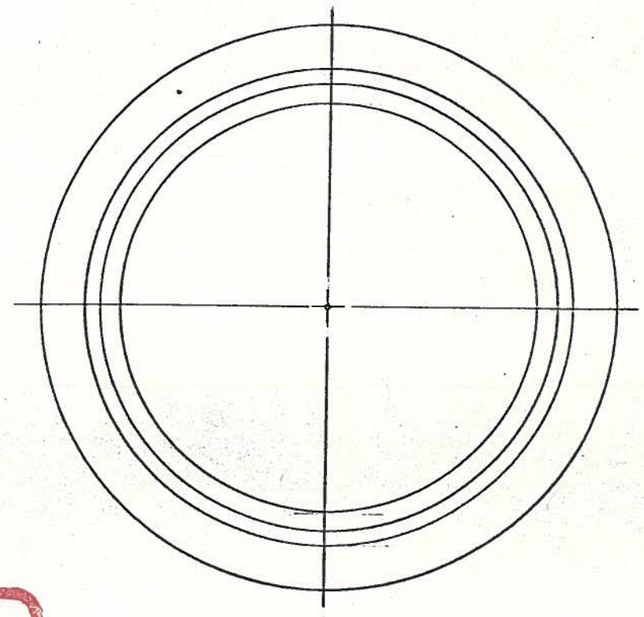
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK No. 76

Scale: N.T.S.		Date: JULY 14 1982		
Drawn by: DAB	Checked by: [signature]	Approved by: [signature]	Drawing No. 91-0121-49	Rev.





VIEW AT SPIGOT END

SHOP DRAWING REVIEW

1 ☑ REVIEWED: MFG. MAY PROCEED
2 ☐ REVIEWED AS MODIFIED: SUBMIT FINAL DWG.
3 ☐ REVISE AND RE-SUBMIT
4 ☐ NOT REVIEWED

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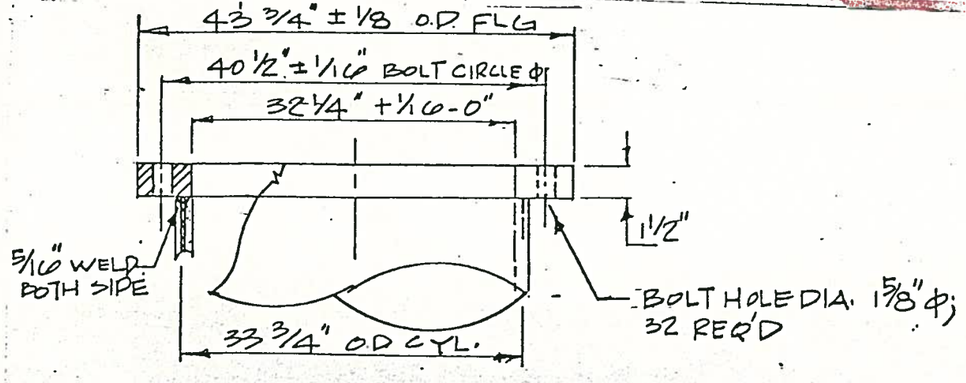
BY _____ DATE Aug 16/82

ASSOCIATED ENGINEERING SERVICES LTD

AESL



DETAIL OF PLATE STEEL FLG (34")ø

TYPE V CEMENT COATING & LINING

SPECIFICATION	: AWWA C303
TYPE	: B
~~CLASS~~/PRESSURE	: (102 PSI)
PLATE THICKNESS	: (3/8")
WIRE MESH—INSIDE	: REF No. A-5-X-133
OUTSIDE	:
WALL THICKNESS	: (3 1/8")

(5/8") EXTRA COATING INCLUDED

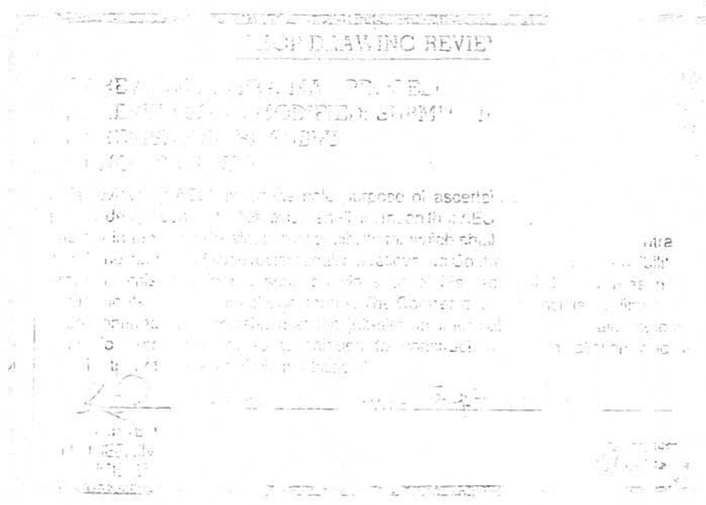
REV.	DATE:	RECORD OF CHANGE	BY:

CANRON LIMITED PIPE DIVISION

COMOX-STRATHCONA S-7
DETAIL OF MK. NO. 77

Scale: N.T.S.		Date: JULY 20 1982		
Drawn by: DAB	Checked by: AHL	Approved by:	Drawing No. 91-012H-50	Rev.

6541



Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

Issue Date:	October 19, 2016	**File:**	20162819.00.E.03.00
Previous Issue Date	None		
To:	Mr. Mike Imrie		
From:	Deryck Irmen, AScT		
Client:	Comox Valley Regional District		
Project Name	Spill Response Plan		
Project No.	2016-2819		
Subject:	Field Visit and Repair Kit Assessment		

TECHNICAL MEMORANDUM

This memo presents Associated Engineering's (AE's) September 23, 2016 field visit findings that will be used to generate a Spill Response Plan and Repair Methodology, as well as to assist with the procurement of a Repair "Kit", in the event of a failure along the Comox Valley Regional District's (CVRD's) force main that conveys raw wastewater from the Courtenay Pump Station (CPS) to the Comox Valley Water Pollution Control Centre (CVWPCC).

1 BACKGROUND

The CVRD owns and operates a major wastewater pump station and 8.7 km force main that service the communities of Courtenay and Comox, BC. The force main that conveys wastewater from Goose Spit to the CVWPCC was installed in the early 80's. The piping system is known today as Bar-Wrapped Pipe (BWP) or "Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type", as the current version of AWWA Standard C303("bar-wrapped" has replaced the original descriptor: "pre-tensioned"). BWP contains a steel cylinder that functions as a watertight conveyance for liquids, while steel reinforcing bars wrapped under tension around the cylinder provide strength. An internal concrete lining and external mortar coating provide corrosion protection to the steel components. When installed, the pipe was sold under the name of "Hyprescon", Hyprescon was purchased by Forterra, a Texas-based company in 2007.

The force main has been protected to an unknown degree by an impressed-current cathodic protection (ICCP) system and anode bed(s). The protection of the full pipe length may be reduced by an anecdotal understanding that many of the bonding straps that bridge the bell and spigot joints may be missing or damaged. Without bonding straps, the corrosion protection systems cannot protect pipe sections that are not in continuous electrical contact.

Due to the age of the piping (30+ years) and the severe operational conditions (raw wastewater inside and a marine environment on the outside), there is concern that the piping could fail. Failure would most likely be due to the corrosion of the mild steel cylinder and/or the mild steel bars and deterioration of the concrete matrix. Consequently, the CVRD has approached AE to assist with providing direction on what materials, AKA repair "kit", should be kept in stock to facilitate a quick repair to the Hyprescon Pipe should there be a failure. Further to recommending materials, a detailed Spill Response Plan will be created, outlining three potential failure areas and scenarios; repair methodology and how to mitigate potential environmental impacts.

2 SITE VISIT

A site visit was conducted on September 23, 2016 by AE's Deryck Irmen. Deryck visited the CVWPCC to visually inspect, assess and document the existing repair materials that are currently being stored onsite. The unlabelled fittings were distributed throughout the site in three different locations, three sections of Hyprescon pipe were located in an uncovered area, while the remaining pieces were found at two different roofed, open-sided buildings.

The results of the repair materials inspection are outlined on the attached Figure 1 "Repair Kit Inventory List". Also see attached photos, under Appendix A, which present the pipe and fittings with painted stencilled identification numbers that correspond to Figure 1 "inventory ID".

After the pipe sections and fittings were located and assessed, the CVWPCC's Chief Operator (Mike Imrie) provided Deryck with a tour of pipe alignment. During this tour, difficulties relating to site access due to tidal and property restraints were observed, and will be taken into consideration with the upcoming Spill Response Plan.

3 CONDITION OF REPAIR MATERIALS

See Figure 1 "Repair Kit Inventory List" for a description of the condition of each fitting presently onsite. Also see attached photos, under Appendix A, which present the pipe and fittings with painted stencilled identification numbers on the exterior corresponding to Figure 1 "Inventory ID".

AE received correspondence from Forterra October 18, 2016, stating that they are uncomfortable with providing reliable commentary based on the photos provided because they are concerned with the possibility of corrosion caused by the environment, and with the weathered concrete allowing moisture to reach the steel. Forterra recommends returning the parts to their Quebec factory for repairs and rehabilitation to provide additional protection and ensure continued shelf life for future reliable use. Sending parts to the factory may provide peace of mind, but it may not be the most cost-effective approach. When sourcing the repair materials in the near future, a cost analysis should be done to determine if there is value in transporting and refurbishing existing materials or, alternately, purchasing only new materials and using existing fittings as secondary replacement parts.

4 REPAIR METHODOLOGIES

AE also received new correspondence from Forterra on October 18, 2016, regarding repair methodologies. Their recommendation generally coincides with AE's repair approach that was sent to CVRD (previously called Regional District of Comox-Strathcona) on December 4, 2001. The forthcoming Spill Response Plan will further outline site-specific repair methodologies; in this memo, a general repair methodology with the fundamental fittings and approach is presented below, for the purpose of noting the deficiencies with the existing repair materials.

A general replacement procedure for BWP at any size will consist of the complete removal of the pipe section, the insertion and pressure-fit of the standard bell-and-spigot-to-plain-steel end adapters on both ends of the existing pipe (the existing pipe will have the corresponding bell-and-spigot ends to accept the adapters). As a result of the standard pipe length of approximately 7.3 m, a gap of 6.065 m will remain to be filled with either a steel or ductile iron plain length of pipe. Compression couplers, manufactured by companies such as Robar and Sigma Blair, can then be positioned (half over the steel/ductile iron spool piece, and half over the bell-and-spigot-to-plain-steel end adapters that were installed on

the existing pipe) and their bolts tightened. Advantages of this approach are: no welding required, quicker installation, and no damage to the lining and coating.

That being said, the CVRD currently lacks the required 6.065 m length of plain-end steel or ductile iron pipe that is needed to replace standard-length sections for all diameters of forcemain; this results in a current inability to replace any pipe sections along any forcemain section. Instead, a repair would need to be done, which may not be as long-lasting as desired.

5 RECOMMENDATIONS AND ACTIONS

As a result of the field visit, AE has made the following preliminary recommendations:

- It is recommended by AE that all existing repair materials be relocated to one covered location for ease of locating in the event of an emergency. In the event of an emergency repair, time will be of the essence; therefore, repair materials should be positioned on top of dunnage so that the materials can quickly and easily be strapped and loaded on to trucks. Straps and harnesses should be stored nearby and should be designated as being for the repair materials. In addition, there should be an outlined "No Storage/Keep Clear Zone" in front of repair materials. This should be clearly marked, as the moving and storing of materials should not impact accessibility of the repair materials over time. ***Action:*** CVRD staff should reorganize existing repair materials under the roofed, open-sided building, and position the materials such that they are easy to load and remove.
- To aid in the identification of repair materials, AE recommends labelling the materials, and a laminated list of materials (with the items numbered and described as per their labels) should be in the immediate vicinity. ***Action:*** During the site visit, Deryck labelled fittings by stencilling identification numbers on the exterior of fittings/pipe; see Figure 1 "Repair Kit Inventory List" under the "Inventory ID" column for field label designations; AE recommends that this approach be continued with all future repair materials that are purchased and stored; laminated copies of the final materials list will be provided.
- Only three Hyprescon O-ring gaskets could be located. The three existing gaskets have been exposed to the elements to an unknown degree for the past 15 years and should be replaced. ***Action:*** AE will add gaskets to the list of recommended materials for the future Repair Kit.
- When sourcing the repair materials, a cost analysis should be done to determine if there is value in transporting and refurbishing existing piping or, alternately, purchasing only new repair materials and using the existing fittings as secondary replacement parts. ***Action:*** AE will do this when assisting with the procurement of the necessary parts.
- Currently with the fittings onsite, the CVRD lacks the 6.065 m length of plain-end steel or ductile iron pipe that is required between the adapters for the replacement of standard-length pipe sections (shorter sections); as mentioned above, this results in the inability to replace pipe sections along the forcemain routes (repairs of unknown efficacy will have to be specified instead). ***Action:*** AE will provide the CVRD with a complete list of repair materials.

AE is currently working on the Spill Response Plan and Repair Methodology, as well as recommendations for new Repair Materials.

Prepared by:

Oct 19/16.

Deryck Irmen, AScT
Civil Technologist

Reviewed by:

Oct 19/16

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
L. MARMOLEJO
29424

Leif Marmolejo, M.Eng., P.Eng.
Project Manager

DI/LM/lp

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature
Date OCT 19 2016 #17-16-014

Figure 1: Repair Kit Inventory List

Inventory ID	Name	Spec	Description	Approx. Diameter (mm)	Length (m)	Quantity in Stock	Condition	Recommendation	
002	Hyprescon Pipe		Hyprescon concrete bell to plain end steel pipe.	Bell 700 I/D, Plain Steel 650 O/D	3.2	1	Good		
003	Hyprescon Pipe		Hyprescon concrete spigot to plain end steel pipe.	Spigot 600 I/D, Plain Steel 650 O/D	3.2	1	Good		
004	Hyprescon Pipe		Hyprescon concrete bell to plain end steel pipe.	Bell 850 I/D, Plain Steel 800 O/D	3.3	1	Signs of weathering to the exterior		For 900-mm-diameter PCCP (Outfall gravity/ force main)?
005	Adapter fitting	C301 (Does not fit C303)	Hyprescon concrete spigot to plain end steel pipe.	Spigot 900 I/D, Plain Steel 900 O/D	0.6	1	Coating for steel flaking off.	Reapply coating	
006	Adpater fitting	C301 (Does not fit C303)	Hyprescon concrete bell to plain end steel pipe.	Bell (could not accurately assess) Plain Steel 900 O/D	0.7	1	Coating for steel flaking off.	Reapply coating	
007	Adapter fitting	C301	Hyprescon concrete spigot to plain end steel pipe.	Spigot 750 I/D, Plain Steel 760 O/D	0.6	1	Coating for steel flaking off.	Reapply coating	For 750-mm-diameter PCCP & 820-mm-diameter BWP (Courtenay Pump Station/ Jane Pump Station force main)
008	Adapter fitting	C301	Hyprescon concrete bell to plain end steel pipe.	Bell 880 I/D, Plain Steel 760 O/D	0.7	1	Coating for steel flaking off.	Reapply coating	
009	Steel Pipe		Cement lined steel plain end spool piece	800	0.9	1	Good		
010	Steel Pipe		Cement lined steel plain end spool piece	650	0.9	1	Good		
200	Hyprescon Pipe		Hyprescon concrete bell to Hyprescon spigot.	Spigot 1040 O/D Bell 1070 O/D	2	1	Exterior concrete presents pitting and uneven finish		For 900-mm-diameter PCCP (Outfall gravity/ force main)?
201	Adapter fitting		Hyprescon bell to plan end steel pipe, C/W thrust ring	Bell 1060 O/D, Plain Steel 900 O/D	1.2	1	Exterior concrete presents pitting and uneven finish. Interior has corrosion and coating delamination.	Determine extent of corrsion. Reapply apply coating.	
202	Adapter fitting		Hyprescon spigot to plan end steel pipe, C/W thrust ring	Spigot 900 I/D, Plain Steel 900 O/D	1.2	1	Good		

Figure 1: Repair Kit Inventory List

Inventory ID	Name	Spec	Description	Approx. Diameter (mm)	Length (m)	Quantity in Stock	Condition	Recommendation
020	Coupling		Smith-Blair slip compression coupling 30x30. C/W gaskets and bolts.	32"x30" Nominal 812.8x762 Nominal	0.3	2	Good	
N/A	Gaskets		Hyprescon gaskets	900		3	Appear good but have been exposed to the elements for the past 15 years.	Replace

*** Color coding to denote the fittings for each different size repairs.

For 750-mm-diameter PCCP & 820-mm-diameter BWP (Courtenay Pump Station/ Jane Pump Station force main)

Inventory ID: 002

Inventory ID: 003

Inventory ID: 005

Inventory ID: 006

Inventory ID: 007

Inventory ID: 008

Inventory ID: 009

Inventory ID: 200

Inventory ID: 200

Inventory ID: 202

Inventory ID: 201

Inventory ID: 004

Inventory ID: 020

Appendix C – Repair and Replacement Materials

1. Procuring New Replacement Materials

   a. Approach

      The CVRD will initially purchase the Replacement Materials listed in this appendix's Table C-1. If and when these materials are utilized, the CVRD should replace them by purchasing new materials. The suppliers listed below are recommended.

   b. Suppliers

      i. Adaptors, gaskets, elbows, couplings, "diapers", steel strap tightener, steel repair patches, and replacement rod/bar (couplings could also be supplied by any number of companies; however, the other items should be supplied by Forterra to ensure that they fit the bells/spigots):

         Domenico Miceli, Sales Director
         Forterra
         699 boul. Industriel
         St-Eustache (Quebec) J7R 6C3
         Email: Domenico.Miceli@forterrabp.com
         Telephone: 450-623-2200 Ext. 333; alternately, 514-820-6189

      ii. Pipe spools (pipe spools could also be supplied by Forterra or any number of companies):

         Jeffrey S. Curl, Sales Representative
         Northwest Pipe Company
         12005 N. Burgard
         Portland, OR 97203
         Email: jcurl@nwpipe.com
         Cell: 503-939-8700
         Telephone: 503-382-2434

2. Required Replacement Materials

   See Table C-1 in this appendix. Also, see Figures C-1, C-2, C-3 and C-4 for details on some of the replacement scenarios.

Table C-1

Repair and Replacement Materials

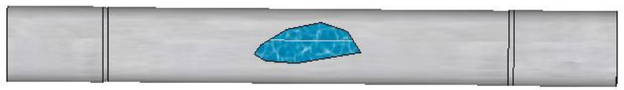
Item No.	Qty.	Size	Length / Angle	Item Name	Item Description	Notes
Repair materials for 450-mm-diameter BWP (for CVWPCC storage areas):						
1	2	450	350 mm x 900 mm	Steel Patch	Steel patch 400 mm x 900 mm, thickness (gauge) to be specified by vendor, matching outside radius of steel cylinder of existing 450 mm BWP.	- for pipe barrel repairs for B303 pipe, refer to page 19 of Forterra repair procedures (see first document in Appendix E)
2	35	Vendor to specify	500 mm	Rod / Bar	Replacement rod/bar pre-rolled to applicable radius of steel cylinder of existing 450 mm diameter BWP. Vendor to specify rod/bar thickness (gauge) and material.	- for pipe barrel repairs for B303 pipe, refer to page 19 of Forterra repair procedures (see first document in Appendix E)
Repair materials for 820-mm-diameter BWP (for CVWPCC storage areas):						
3	2	820	400 mm x 900 mm	Steel Patch	Steel patch 400 mm x 900 mm, thickness (gauge) to be specified by vendor, matching outside radius of steel cylinder of existing 820 mm BWP.	- for pipe barrel repairs for B303 pipe, refer to page 19 of Forterra repair procedures (see first document in Appendix E)
4	70	Vendor to specify	700 mm	Rod / Bar	Replacement rod/bar pre-rolled to applicable radius of steel cylinder of existing 820 mm diameter BWP. Vendor to specify rod/bar thickness (gauge) and material.	- for pipe barrel repairs for B303 pipe, refer to page 19 of Forterra repair procedures (see first document in Appendix E)
Repair materials for 750-mm-diameter PCCP (for CVWPCC storage areas):						
5	1	750	900 mm	Repair Saddle	Prefabricated 2-piece weld-on repair saddle for existing 750 mm diameter PCCP pipe. 900 mm long, w/ 3" coupling with plug for vent and drain. Steel plate thickness to match existing pressure requirements, vendor to specify.	- for pipe barrel repairs for L301 pipe, refer to pages 20-25 of Forterra repair procedures (see first document in Appendix E)
6	2	750		Bolt-on Clamps	Bolt-on-clamps to allow the cutting of high-strength wires on 750 mm diameter PCCP, for weld-on repair. Vendor to specify type.	- for pipe barrel repairs for L301 pipe, refer to pages 20-25 of Forterra repair procedures (Appendix E)
Replacement materials for 450-mm-diameter BWP (for CVWPCC storage areas):						
7	1	450	700 mm	Adaptor	Bell (AWWA C303 BWP) End x Plain End Steel ASTM A53GrB (or A106GrB), standard weight, seamless or welded, Coating & Lining to AWWA C210	- include gasket
8	1	450	700 mm	Adaptor	Spigot (AWWA C303 BWP) End x Plain End CS Steel A53GrB (or A106GrB), standard weight, seamless or welded, Coating & Lining to AWWA C210	- include gasket
9	2	450		Gaskets	w/ lubricant, for C303 BWP	- for spares
10	3	450		Coupling	Robar 1906 (or equivalent), 1906-1/4 x 10, epoxy coated, SS (316) fasteners, 10" sleeve	- Dresser, Smith-Blair or equivalent
11	2	450	5883 mm	Pipe Spool	Pipe Steel ASTM A53GrB (or A106GrB), standard weight, seamless or welded, coating & lining to AWWA C210. Includes: - 450mm ASME B16.9 Standard weight A234 GrWPB Butt-weld Tee welded center of pipe spool - CL150 ASME B16.5 or AWWA C207 Class E Flange slip-on or welded, raised face and matching blind flange - gasket, red rubber, 3mm, meet B16.5 or AWWA C207 requirements and service conditions - A193 GrB8M Cl.1 hex head bolts and A194 Gr8M hex head semi-finished	- Spool to have Plain Ends - flange/blind is for tee branch - spool (inc. tee, flange & blind) coating & lining to AWWA C210
12	1	450	7315 mm	Pipe	Pipe Steel ASTM A53GrB (or A106GrB), standard weight, seamless or welded, plain ends, coating & lining to AWWA C210.	
13	2	450		Diapers	Joint installation diaper	- as per Forterra installation procedures in Appendix E
14	2	450		Diaper Tool Kit	Steel strap tightener, crimping tool, crimps, wedges, etc.	- as per Forterra installation procedures in Appendix E

Table C-1						
Repair and Replacement Materials						
Item No.	Qty.	Size	Length / Angle	Item Name	Item Description	Notes
Replacement materials for 750/820-mm-diameter PCCP/BWP (for CVWPCC storage areas):						
15	2	750	700 mm	Adaptor	Bell (AWWA C301(L) PCCP) End x Plain End Steel ASTM A139 GrB (or API 5L GrB), standard weight, seamless or welded, coating & lining to AWWA C210	- the 750 PCCP and the 820 BWP have the same bell/spigot dimensions, - include gaskets
16	2	750	700 mm	Adaptor	Spigot (AWWA C301(L) PCCP) End x Plain End Steel ASTM A139 GrB (or API 5L GrB), standard weight, seamless or welded, coating & lining to AWWA C210	- the 750 PCCP and the 820 BWP have the same bell/spigot dimensions, - include gaskets
17	8	750		Gaskets	w/ lubricant, for C301(L) PCCP	- The 750 PCCP and the 820 BWP have the same bell/spigot dimensions. - for spares
18	4	750		Coupling	Robar 1906 (or equivalent), 1906-1/4 x 10, epoxy coated, SS (316) fasteners, 10" sleeve	- Dresser, Smith-Blair or equivalent
19	2	750	5883 mm	Pipe Spool	Pipe Steel ASTM A139 GrB (or API 5L GrB), standard weight, seamless or welded, coating & lining to AWWA C210. Includes: - 750mm B16.9 Standard weight A234 GrWPB Butt-weld Tee welded center of pipe spool - AWWA C207 Class E Flange slip-on, flat faced with serrated finish - gasket, red rubber, 6mm, meet AWWA C207 requirements and service conditions - A193 GrB8M Cl.1 hex head bolts and A194 Gr8M hex head semi-finished	- Spool to have Plain Ends - flange/blind is for tee branch - spool (inc. tee, flange & blind) coating & lining to AWWA C210
20	2	750	7315 mm	Pipe	Pipe Steel ASTM A139 GrB (or API 5L GrB), standard weight, seamless or welded, plain ends, coating & lining to AWWA C210.	
21	4	750	11.25 deg	Elbow	AWWA C301(L) bell & spigot PCCP Elbow	- include gaskets
22	2	820		Diapers	Joint installation diaper	- as per Forterra installation procedures in Appendix E - for both 750/820-mm-diameter PCCP/BWP
23	2	820		Diaper Tool Kit	Steel strap tightener, crimping tool, crimps, wedges, etc.	- as per Forterra installation procedures in Appendix E - for both 750/820-mm-diameter PCCP/BWP

FIGURE C-1

REPLACEMENT #1:
REPLACEMENT OF ONE (1) LENGTH OF PIPE (N.T.S.)

1. IDENTIFY LOCATION OF LEAK



2. REMOVE ONE (1) DAMAGED PIPE AND PREPARE BASE

3. INSTALL BELL X PLAIN STEEL END ADADPTER AND SPIGOT X PLAIN STEEL END ADAPTER TO EXISTING BAR WRAPPED PIPE

4. SLIDE COMPRESSION COUPLINGS ON TO PLAIN END STEEL PIPE AND CUT LENGTH OF STEEL TO SUIT REPAIR

5. ALIGN STEEL PIPE AND SLIDE COMPRESSION COUPLINGS INTO POSITION

6. TIGHTEN COMPRESSION COUPLINGS TO MANUFACTURER'S SPEC'D TORQUE

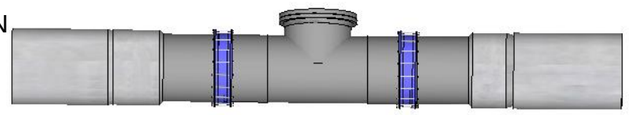
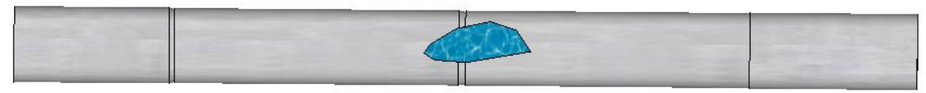


FIGURE C-2

REPLACEMENT #2:
REPLACEMENT OF TWO (2) ADJACENT LENGTHS OF PIPE (N.T.S.)

1. IDENTIFY LOCATION OF LEAK

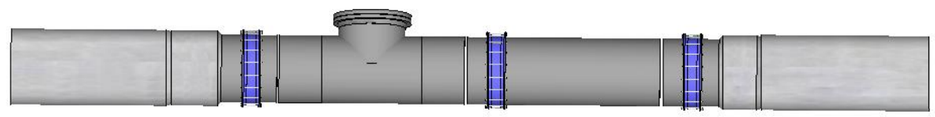


2. REMOVE TWO (2) DAMAGED PIPES AND PREPARE BASE

3. INSTALL BELL X PLAIN STEEL END ADADPTER AND SPIGOT X PLAIN STEEL END ADAPTER TO EXISTING BAR WRAPPED PIPE

4. SLIDE COMPRESSION COUPLINGS ON TO PLAIN END STEEL PIPE AND CUT LENGTH OF STEEL TO SUIT REPAIR

5. ALIGN STEEL PIPE AND SLIDE COMPRESSION COUPLINGS IN TO POSITION



6. TIGHTEN COMPRESSION COUPLINGS TO MANUFACTURER'S SPEC'D TORQUE

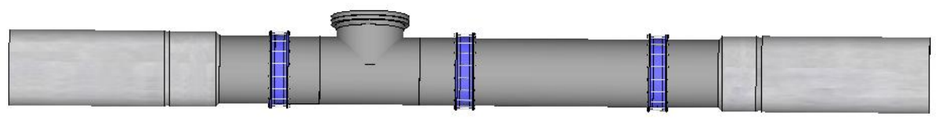


FIGURE C-3

REPLACEMENT #3: REPLACEMENT OF ONE (1) PIPE LENGTH AND ONE (1) PIPE BEND (N.T.S.)

1. IDENTIFY LOCATION OF LEAK

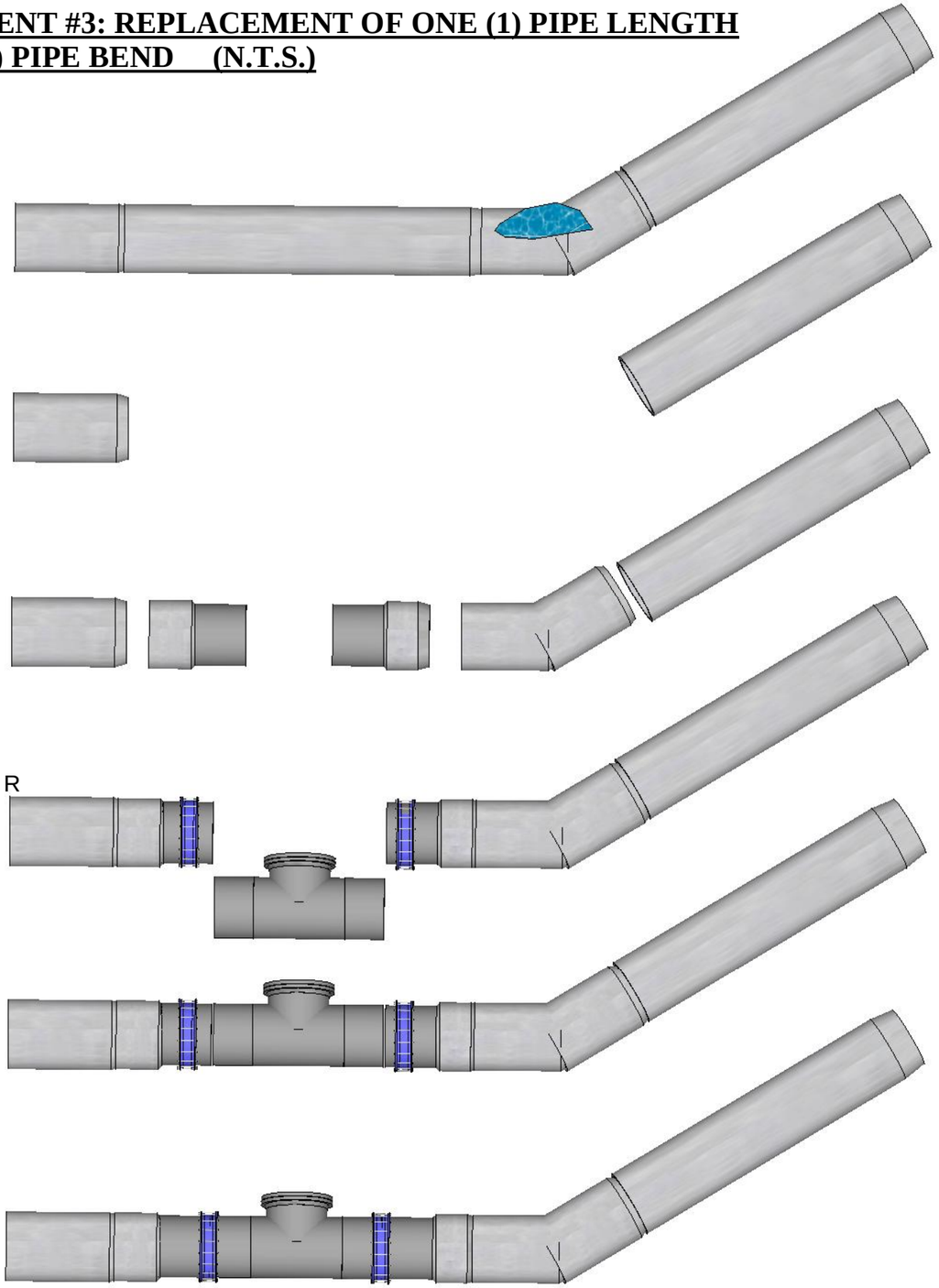
2. REMOVE DAMAGED BEND, ONE (1) PIPE LENGTH AND PREPARE BASE

3. INSTALL BELL X PLAIN STEEL END ADAPTER, SPIGOT X PLAIN STEEL ADAPTER AND BEND

4. CUT STEEL PIPE TO SUIT REPAIR AND SLIDE COMPRESSION COUPLINGS ONTO PIPE

5. ALIGN STEEL PIPE AND SLIDE COMPRESSION COUPLINGS INTO POSITION

6. TIGHTEN COMPRESSION COUPLINGS TO MANUFACTURER'S SPEC'D TORQUE

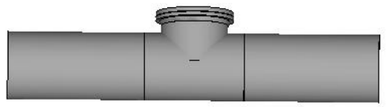


REPLACEMENT PARTS LIST AND LEGEND

LEAK LOCATION

STANDARD LENGTH OF C-303 BAR WRAPPED OR C-301 PRESTRESSED CONCRETE CYLINDER BELL AND SPIGOT PIPE (L=7.315m)

C-303 OR C-301 BELL X PLAIN STEEL END
C-303 OR C-301 SPIGOT X PLAIN STEEL END



STEEL FLANGED TEE SECTION C/W BLIND FLANGE AND GASKET

LENGTH OF STEEL PIPE

ROBAR 1906 COMPRESSION COUPLER

BELL AND SPIGOT BEND (LENGTH & ANGLE EXAGGERATED)

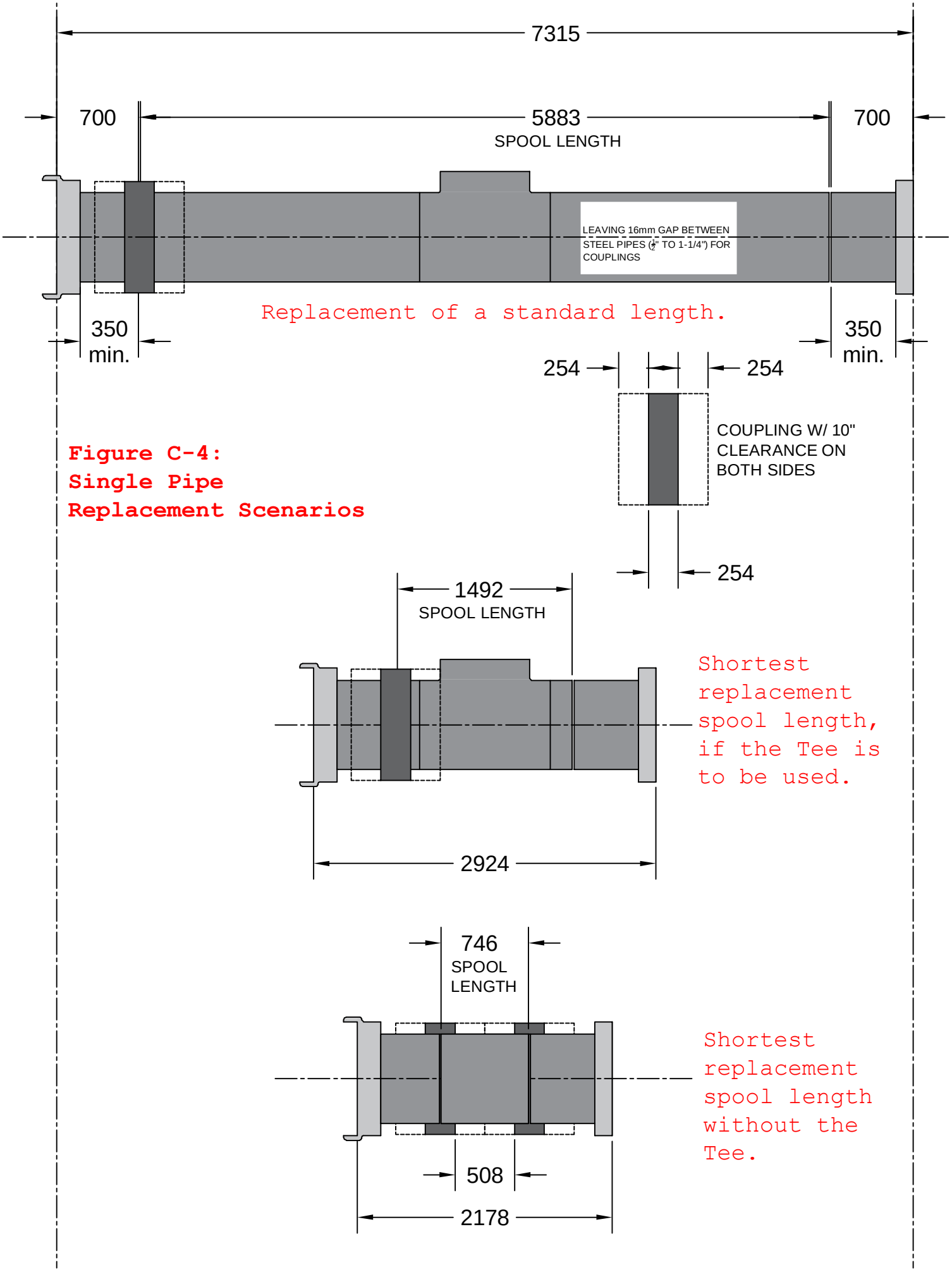


Figure C-4: Single Pipe Replacement Scenarios

Appendix D - Emergency Repair Questionnaire

Emergency Repair Questionnaire

Answer the following to aid in the planning and methodology of a failure:

1. **Using the documents in Appendix B of the Spill Response Plan, what section is the failure located at? Circle the best answer.**

   The Wastewater Force Main Drawings (alignments, plans and sections; Associated Engineering, 1983) will help determine if the failure is in the section from:

- Courtenay Pump Station to Jane Street (750-mm-diameter PCCP);
- Jane Street Pump Station to main force main (450-mm-diameter BWP);
- Jane Street to Goose Spit (820-mm-diameter BWP);
- Goose Spit to the CVWPCC (820-mm-diameter BWP);
- CVWPCC to Cape Lazo Marine Outfall (900-mm-diameter PCCP).

2. **If drawings are not accessible, what is the address or location description of failure?**

   _____

3. **What is the flow rate of leak? If feasible, use 5-gallon bucket and count to 30 seconds, multiply results by 2 for Gallon Per Minute. Circle the best answer.**

   <5 GPM 5-10 GPM >5 GPM

4. **What type of failure is present? Circle the best answers.**

   - Pipe failure
     - One pipe section
     - Two pipe sections

   - Joint failure between two straight sections
     - Is one side of the joint reusable?
       - Yes: the bell side; the spigot side
       - No (both sides of the joint/both straight sections need replacement)

   - Fitting failure
     - Elbow/Bend; approximate angle (degrees): _____
     - Wye
     - Tee
     - Adapter

5. **Dimensions of damaged area?**

   _____

6. **What is the diameter of the pipe? Circle the best answer.**

450 mm 750 mm 820 mm 900 mm (outfall gravity/force main)

7. **Do adjacent connections appear damaged?**

   _____

8. **Do you have clear access to failure location?**

   _____

9. **What is the laying length of the damaged pipe(s) and or fitting(s)?**

   _____

Date and time of Questionnaire completion: _____

Name of author and contact information: _____

_____

Upon completion of questionnaire copies are to be made and distributed to the Spill Response Team.

Prior to excavation, contact BC One Call (1-800-474-6886) to locate existing services.

Comments, sketches and observations (use backside of sheet if needed):

Appendix E - Forterra Procedures

Introduction

Pressure pipe, when properly designed, manufactured and installed, will provide safe, reliable and continuous service under normal and transient conditions. Unfortunately, due to accidents or other unforeseen circumstances, it is sometimes necessary to repair or replace a pipe in the line.

Though durable, this pipe is not designed to withstand impact from a backhoe, jackhammer or an auger. This Repair Guide will provide a course of action to follow should such an event occur.

Forterra Pressure Pipe stocks repair and replacement clamps, saddles, pipe sections, closures and other materials at most of our manufacturing facilities. The fittings department can quickly fabricate non-stock repair materials from its steel plate inventory.

This Guide describes the most common repair procedures; however, not all repairs are covered. Forterra Pressure Pipe's field representatives have extensive knowledge in repair procedures and can usually offer a practical solution to most situations. They are available for assistance in an emergency 24 hours a day. See contact information on the following page.

For the best feedback in an emergency, make a record of the types and sizes of pipe in the system. It may also be helpful to provide a sketch showing the location, size and type of pressure pipe. Use the Emergency Repair Questionnaire on page three.

Emergency Phone Numbers

Forterra Pressure Pipe field services are available 24 hours a day for emergency repairs.
In the U.S., call: 972 262 3600 during normal business hours Central Standard Time or 800 445 1534 evenings, weekends and holidays. In Canada, call: 888 497 7371.

Note

All operations described in this Guide should be performed in accordance with Occupational Safety and Health Act (OSHA) regulations, provincial, state and local codes and recognized safe practices.
Material handling equipment shown or described in this Guide should have sizes and capacities determined by a qualified person.

Making a Durable Repair

Completed repairs on concrete and steel pressure pipe should provide both the strength to contain the pipeline pressure and protection from corrosion.

Pressure containment strength is generally established by assuring adequate gasket compression, by welding, by installing additional circumferential reinforcement on existing pipe or by pipe replacement.

Corrosion protection of the repair is generally provided by coating all exposed steel with a 1" (25 mm) minimum thickness of Portland cement mortar.

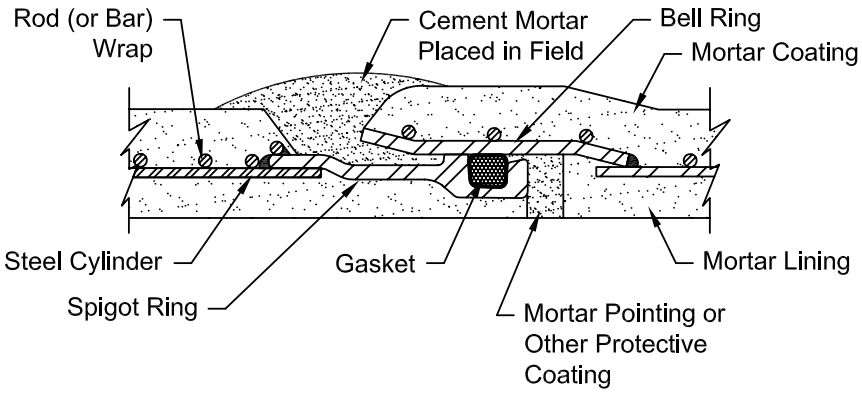
If the pipeline being repaired is bonded for monitoring or cathodic protection, the repair steel should also be electrically connected to the pipeline steel.

The proper procedure to repair leaks in damaged pressure pipe depends on the pipe type. The type of pipe determines whether the pipe has a cylinder, the location of the cylinder in the pipe wall and whether the pipe is prestressed.

Types of Concrete Pressure Pipe

B-303

The most common type of concrete pressure pipe manufactured by Forterra Pressure Pipe is Bar-Wrapped Cylinder Concrete Pipe (B-303). Prior to 1970, this pipe was known as American concrete cylinder pipe or P-381. From 1970 to 1995, it was marketed as Pretensioned Concrete Cylinder Pipe (P-303). This pipe is manufactured in diameters ranging from 10" (250 mm) to 64" (1600 mm). The bell, spigot, cylinder and spiral reinforcing rod on this pipe are all made of mild steel and can be welded. However, the cylinder for B-303 and other types of concrete pressure pipe can be as thin as 16 gauge (0.0598"/1.5 mm), so only welders experienced in making watertight welds on thin steel should attempt welding repairs on concrete pipe cylinders.



Note

The bell, spigot, cylinder and spiral reinforcing rod on B-303 pipe are all made of mild steel and can be welded.

Caution

If the cylinder is 14 gauge (0.0747"/1.9 mm) or thinner, only a welder with experience on concrete pressure pipe should attempt the repair.

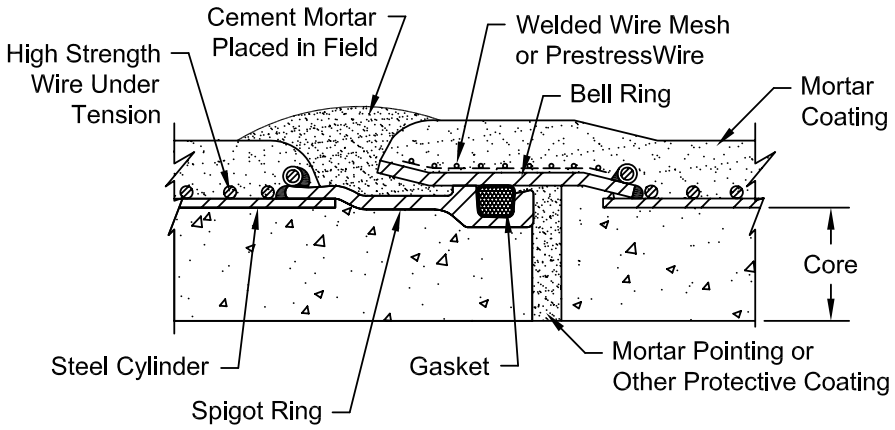
Types of Concrete Pressure Pipe (Cont.)

L-301

Forterra Pressure Pipe currently manufactures two other types of concrete pressure pipe: Prestressed Concrete Lined Cylinder Pipe (L-301). L-301 pipe has been manufactured in 16" (400 mm) through 60" (1500 mm) diameters.

The bell, spigot and cylinder of this pipe are made of mild steel and the cylinder is usually 16 gauge (0.0598"/1.5 mm) material. The spiral prestressing wire is very high strength steel and cannot be welded. For this reason, repair procedures for these types of pipe usually use circumferential clamps or similar materials which do not require structural support from the prestressing wire.

L-301



Repair Procedures

Quick Reference

Typical repair procedures for various types of pipe and conditions are listed here. Some repairs can be made with the pipeline pressurized, provided there is no leak with sufficient water volume or pressure to endanger repair personnel.

Other repairs can be made with the pipeline full but depressurized in order to reduce leakage to a level which will not interfere with the installation of the repair. Where pipe sections must be replaced, the line must be drained.

Any steel used in repairs on electrically bonded pipelines must be made electrically continuous with the pipeline steel and all repair and pipe steel must be properly protected with Portland cement mortar.

Repair Procedures (Cont.)

Quick Reference (Cont.)

Problem	Repair	Page
L-301		
■ Joint repairs during new pipe installation		
– Bent joint ring	Heat & reshape or weld on new joint ring	16
– Insufficient joint overlap		
■ All diameters	Exterior joint weld	17
■ Joint repairs on existing pipe		
– Pipe under low or no pressure		
■ All diameters – slight or no seeping	Exterior joint weld	17
■ Pipe barrel repairs		
– Pipe under pressure	Weld-on repair saddle	20-25

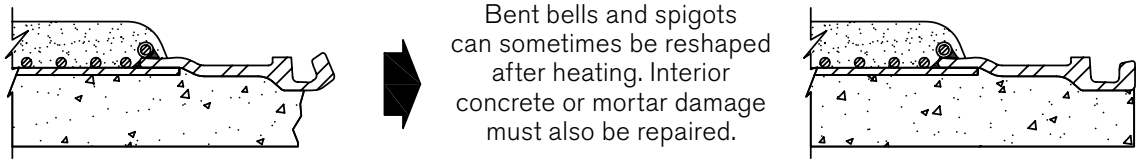
Repair Procedures (Cont.)

Heat & Reshape

■ B-303 and L-301 Repair Procedure

1. Joint rings which are misshaped due to being bumped during or after delivery can sometimes be heated and hammered back to essentially their original configuration. Such a repair must only be made: (a) with the approval of the owner's inspector or representative; and (b) under the supervision of a Forterra Pressure Pipe field representative.

2. After the bell or spigot is repaired, all broken mortar or concrete around the repair must be removed and replaced.



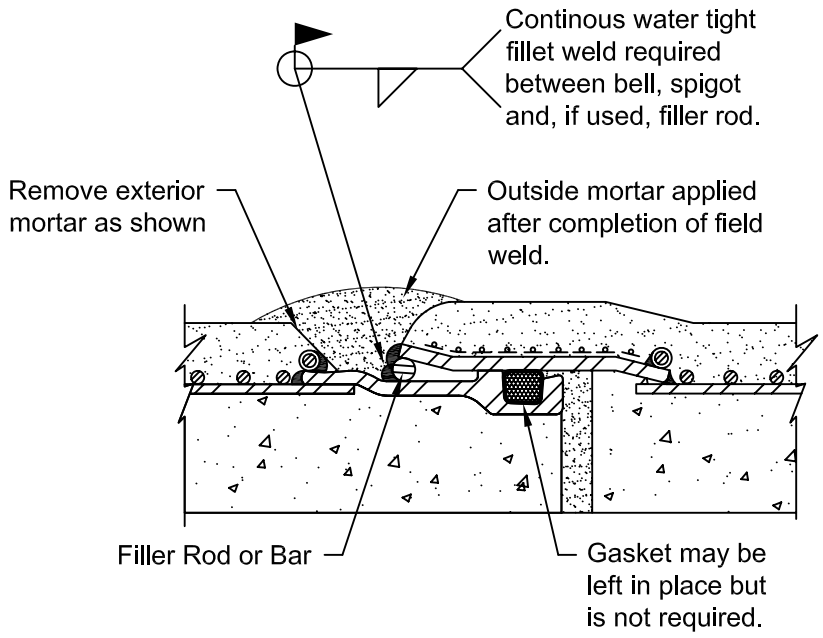
Bent bells and spigots can sometimes be reshaped after heating. Interior concrete or mortar damage must also be repaired.

Repair Procedures (Cont.)

Exterior Joint Weld

■ **B-303, L-301 Repair Procedure**

1. Remove sufficient exterior mortar to provide access for complete circumferential weld. Use caution to avoid breaking the prestressing wire on L-301 pipe or the rod reinforcement on B-303 pipe.
2. Reduce the gap between materials to be welded. This may require the use of a filler rod or bar, or heating and flattening the bell flare, or similar preparation, depending upon the extent of joint overlap.
3. Place a continuous, watertight weld around the entire circumference of the joint.
4. Repair exterior mortar or concrete.



Note

The weld must be continuous and watertight, so the gasket is not needed. The joint configuration and need for filler material will vary depending on joint overlap.

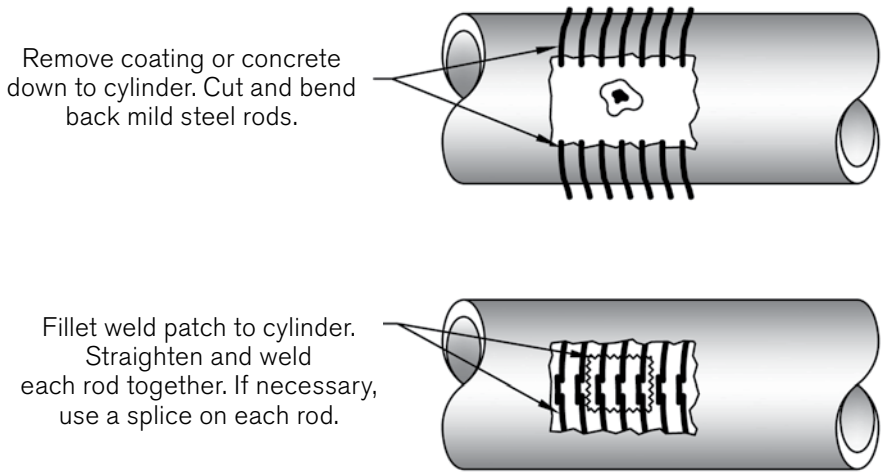
Repair Procedures (Cont.)

Welded Repair

■ B-303 Repair Procedure

1. Remove the mortar coating or concrete down to the cylinder within a few inches around the damaged area. Cut and bend back reinforcing rods.
2. Center a steel patch over the hole in the cylinder and weld it in place with a watertight fillet weld around the perimeter of the patch (see Caution). Straighten and weld the cut reinforcing rods back together. If necessary, use a splice on each wrap.
3. Cover all exposed steel with a 1" (25 mm) minimum thickness cement mortar.

B-303



Caution

This repair requires welding to a pipe cylinder which may be as thin as 16 gauge (0.0598"/1.5 mm). Only welders experienced in making watertight welds on thin steel should attempt this procedure.

Repair Procedures (Cont.)

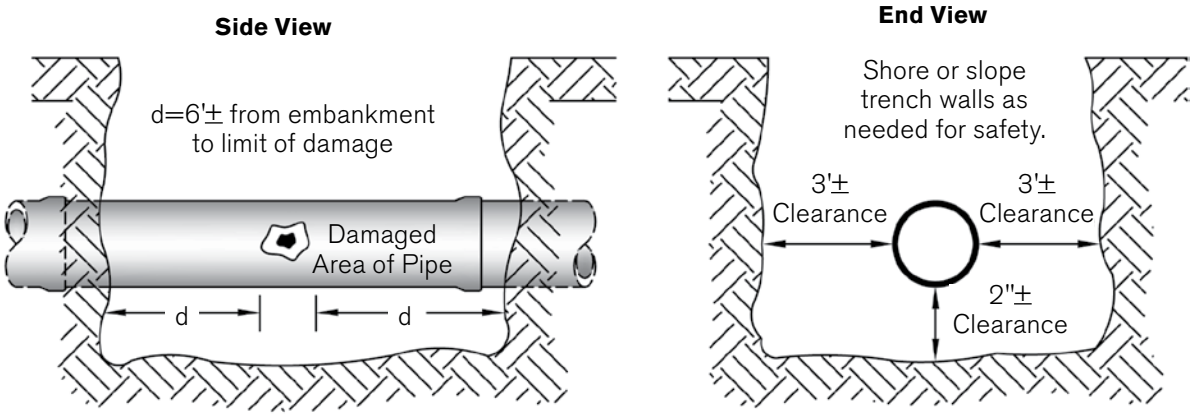
Weld-On Repair Saddle

■ **L-301 Repair Procedure**

Although the standard repair saddle width is 24" (609 mm) wide, longer repair saddles may be quickly fabricated if needed.

1. Excavate necessary clearance around the damaged area of pipe for installation of repair saddle. Recommended clearances are shown in sketch.

2. Remove a 5" (127 mm) wide area of mortar coating or exterior concrete around the entire circumference of the pipe cylinder on each side of the damaged area. The standard repair saddle is 24" (609 mm) wide, thus the centerlines of the chipped areas should be approximately 24" (609 mm) apart. Please note it is neither necessary nor desirable to remove all the mortar coating or exterior concrete surrounding the damaged area of the pipe.



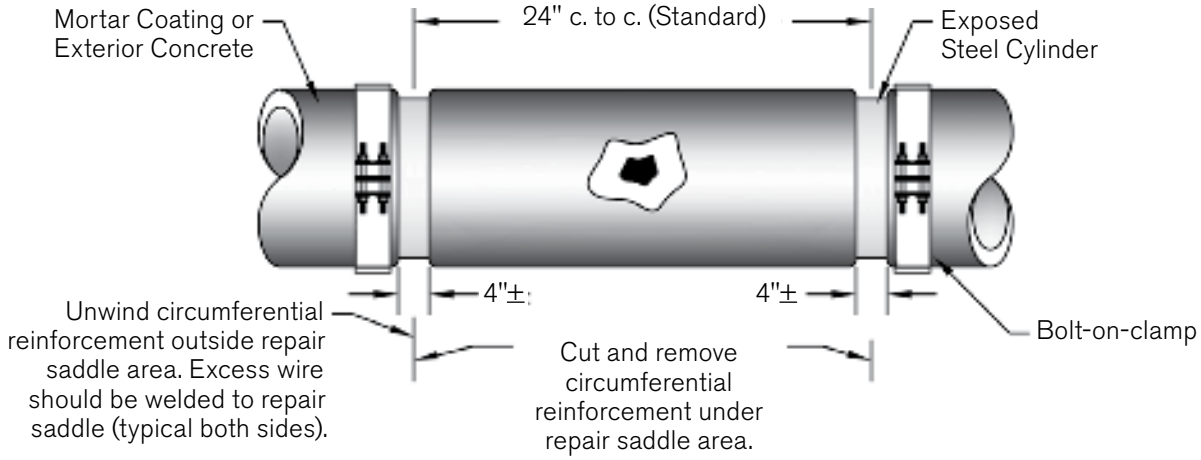
Repair Procedures (Cont.)

Weld-On Repair Saddle (Cont.)

■ **L-301** **Repair Procedure** (Cont.)

3. Cut and remove circumferential reinforcement in the area of each 5" (127 mm) band which will be under the repair saddle. Unwind the circumferential reinforcement in the area of each band which will be outside the repair saddle. This exposes the bare cylinder for welding.

L-301



Repair Procedures (Cont.)

Weld-On Repair Saddle (Cont.)

■ **L-301** **Repair Procedure** (Cont.)

4. Remove the plugs and place the two halves of the repair saddle around the pipe. Tighten the halves together using a set of come-alongs. Weld the two halves of the repair saddle to the pipe and each other using watertight welds (see Caution). One outlet is positioned at the bottom to allow water to escape.

5. Rewind the circumferential reinforcement outside each end of the saddle around the pipe so it is placed in its original location. Weld each free end of the reinforcement to the saddle or, for prestressing wire, place a full circle bolt-on-clamp on either end of the weld-on-clamp and tighten down on the outside of the mortar coating.

6. Install the plugs in the couplings.

7. Inspect the repair saddle for any leaks and repair as necessary.

8. If possible, drain the recess between the saddle and pipe and refill it with a cement slurry.

9. Reinstall and tighten plugs.

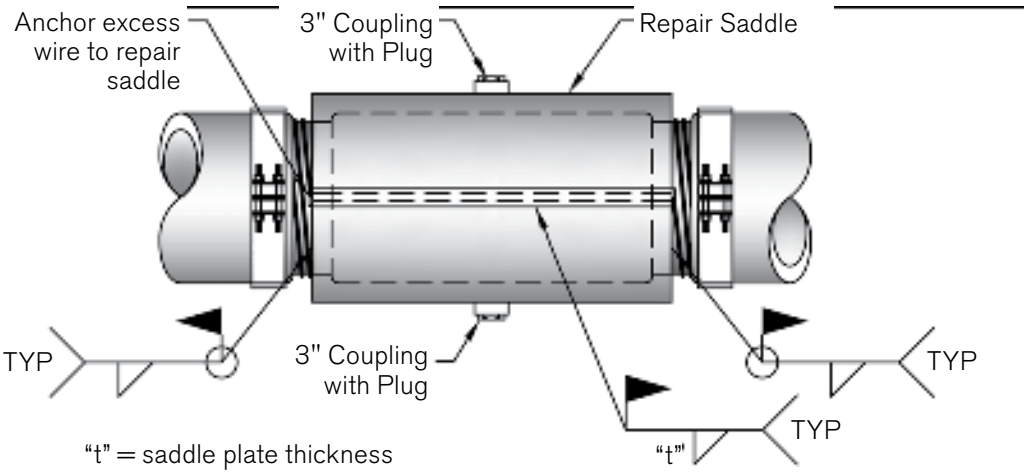
10. Protect all exposed steel with a 1" (25 mm) minimum thickness cement mortar.

Repair Procedures (Cont.)

Weld-On Repair Saddle (Cont.)

■ **L-301** **Repair Procedure** (Cont.)

L-301



Caution

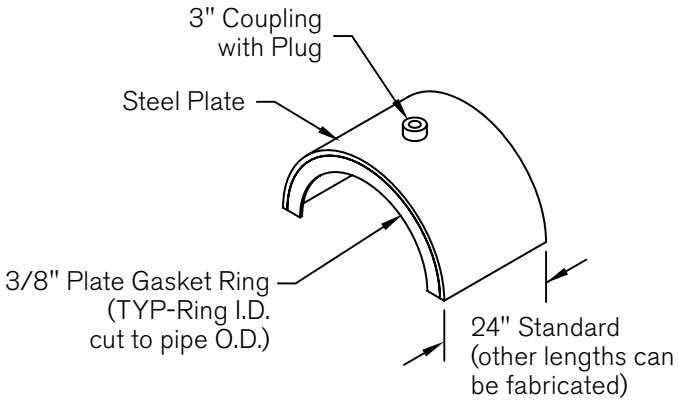
This repair requires welding to a pipe cylinder which may be as thin as 16 gauge (0.0598"/1.5 mm). Only welders experienced in making watertight welds on thin steel should attempt this procedure.

Repair Procedures (Cont.)

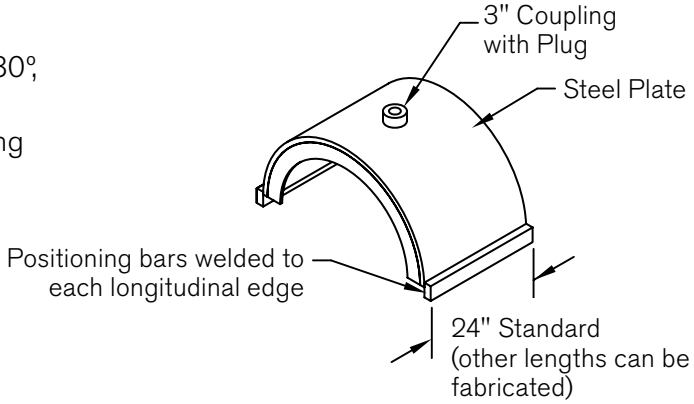
Weld-On Repair Saddle (Cont.)

■ **L-301**

Top Piece:
steel plate typically 24" long, rounded 180°, with 3" coupling with plug, attached to two 3/8" plate 180° rings.



Bottom piece:
steel plate, typically 24" long, rounded 180°, with full length "t" thickness bars welded to each longitudinal edge, with 3" coupling with plug, attached to two 3/8" plate 180° rings.



Note

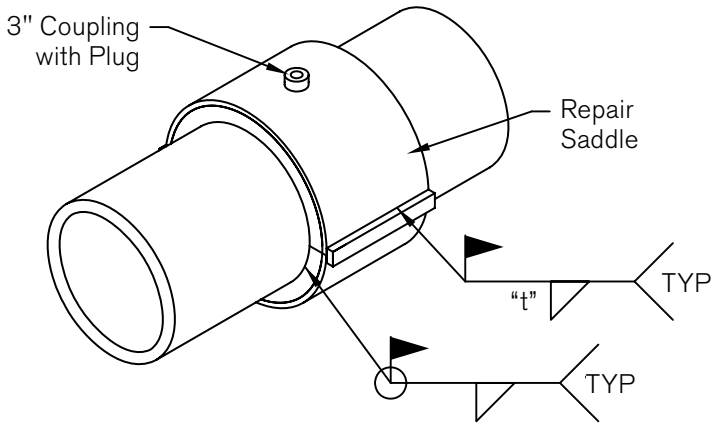
Steel plate thickness "t" (in inches) may be calculated by the formula:

$$\text{"t" Min} = \frac{\text{(I.D. Saddle) (Working Pressure)}}{\text{2 (15,000 psi Steel Stress)}}$$

Repair Procedures (Cont.)

Weld-On Repair Saddle (Cont.)

■ **Assembled Repair Saddle**

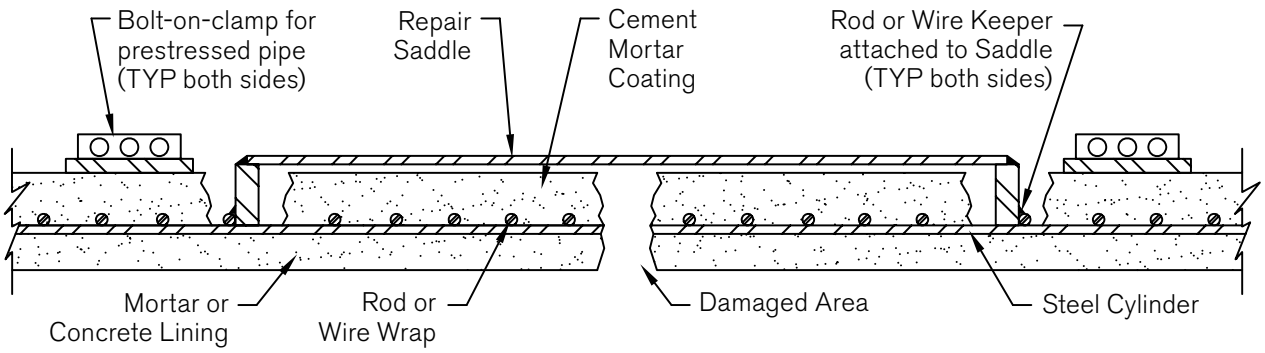


Note

"t" = Saddle plate thickness.

Coating and rod or wire not shown for clarity.

Cross Section View



Repair Procedures (Cont.)

Dry Tap

■ B-303 Repair Procedure

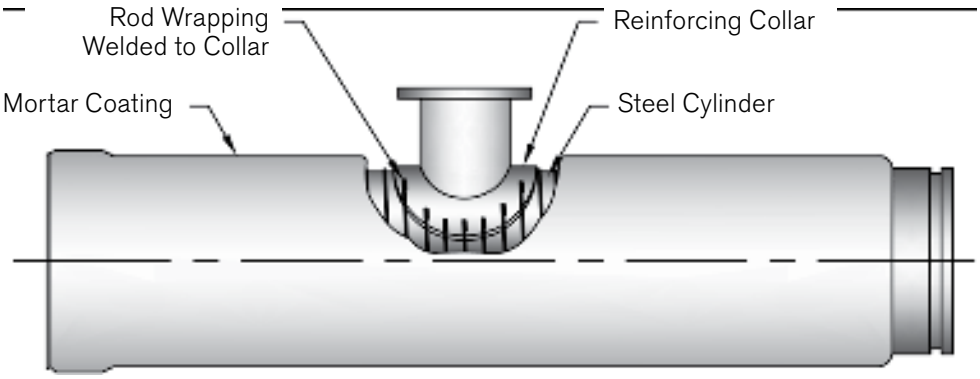
1. Place steel reinforcing collar on pipe centered at the desired location of the outlet and mark an area approximately 2" (50 mm) larger than the area covered by the collar. Remove all coating within this area. Again, place the collar on the pipe at the desired location and mark on the reinforcing rods the outer limits of the collar. Remove the collar and flame cut the rods about 1" (25 mm) inside the area marked. Bend the rods away from the pipe cylinder to permit placing the collar on the cylinder.

2. Place collar on cylinder and weld collar to cylinder around outside of collar using a watertight weld (see Caution). Bend reinforcing rods down against collar and weld rods securely to collar.

3. Position outlet neck in center of outlet opening. Mark opening from inside of outlet. Remove outlet neck and flame cut cylinder as marked. Carefully remove mortar lining from outlet area.

4. Position outlet neck over opening and weld around outside, completely filling space between collar and outlet neck with weld metal, making sure a strong watertight weld is obtained.

5. Close the outlet in a manner that assures watertightness. Cover all exposed steel with a 1" (25 mm) minimum thickness cement mortar.



Caution

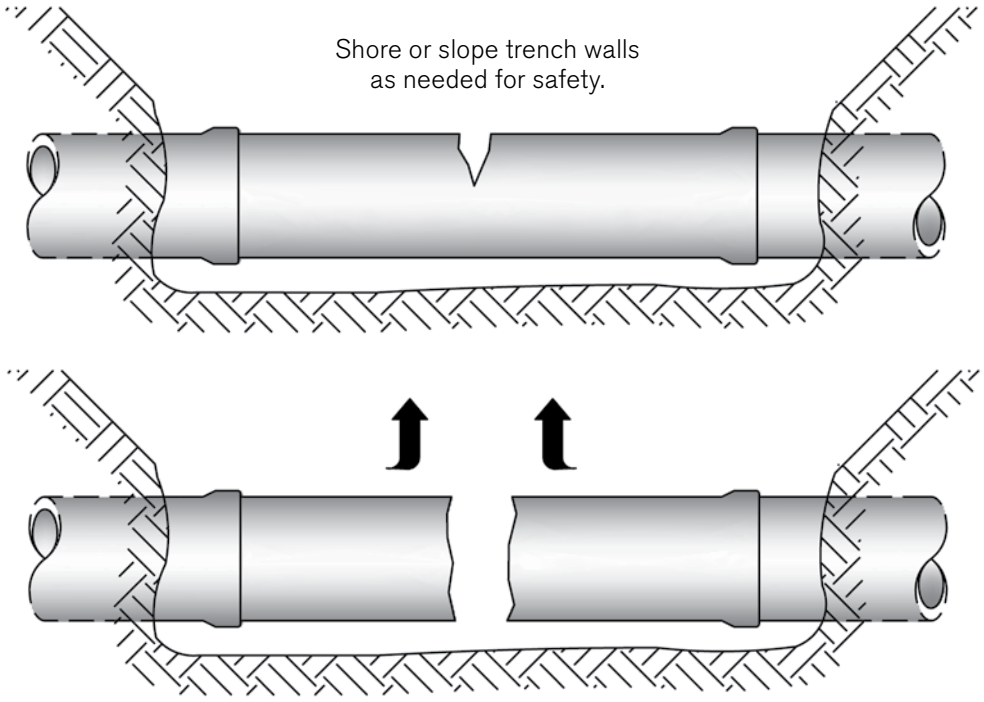
This repair requires welding to a pipe cylinder which may be as thin as 16 gauge (0.0598"/1.5 mm). Only welders experienced in making watertight welds on thin steel should attempt this procedure.

Repair Procedures (Cont.)

Damaged Pipe Removal for Closure Placement

■ All Types of Concrete Pressure Pipe Repair Procedure

1. Excavate the area around the damaged section of pipe to adequately expose its entire length.
2. Cut or break out a section approximately 12" (304 mm) long from the damaged pipe. On prestressed or pretensioned pipe this can be accomplished by: (1) chipping a 12" (304 mm) longitudinal by 2" (50 mm) circumferential slot in the coating to expose the wire or rod wrap; (2) cutting the wire or rod with a chisel or torch, (thus safely relieving the wire stress if the pipe is prestressed; (3) forcing a chisel or chipping gun between the wire or rod and the substrate and peeling the wrap and coating off; and (4) cutting the remaining cylinder or core with a torch and/or chipping gun. Alternatively, all types of pipe can be broken with backhoe teeth, a pneumatic spade or with a carbide-tipped circular saw. All steel can be severed with a cutting torch (though workers should avoid hand-cutting stressed, unrestrained prestress wire because of the potential for injury from wire recoil).
3. Carefully work each remnant pipe end up and down until its joint disengages in a manner that does not damage the adjacent pipe joints. Remove the remnants and clean the adjacent bell and spigot in the trench. If necessary, stabilize the subgrade with crushed rock or other suitable material.



Note

Equipment required: backhoe or drag-line for excavation; backhoe, crane or side-boom tractor for handling pipe; cutting torch; air compressor, water pump hoses, chains, cable slings, lights, ratchet type hoists.

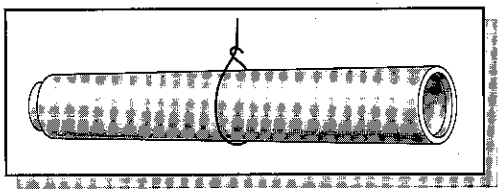
INSTALLATION MANUAL

INDEX

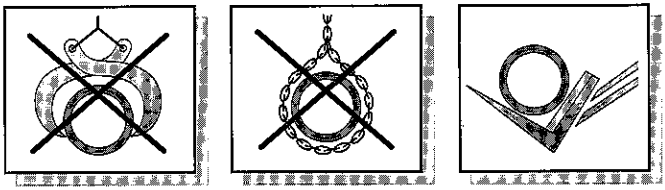
For all additional information and questions,
do not hesitate to contact us.
Our technicians will be pleased to assist you
at any stage of construction.
This service is available 24 hours a day.

INSTALLATION PROCEDURE

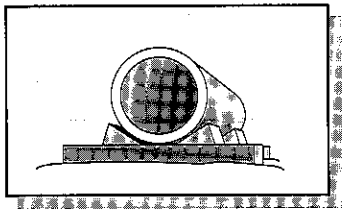
HANDLING AND STORAGE



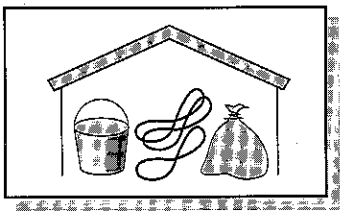
Pipe handling must be done using one or two steel cables or nylon belts centered on the pipe.



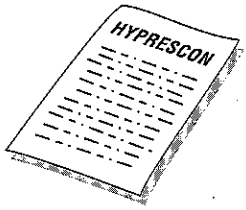
Lifting clamps, chains are not recommended.
Note: Rubber or wood padded forks can be used.



Store pipes on wooden blocks along the trench to avoid unnecessary transport and handling.

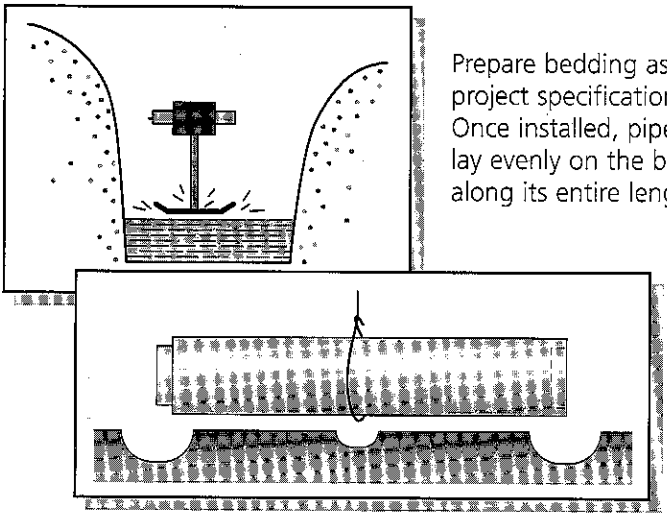


Accessories such as lubricant, gaskets etc., should be stored in a warm and clean place. **Gaskets must not be installed in advance.**



Upon delivery of pipe, check to see if pipes, fittings and accessories are delivered as per the packing slip. Report immediately any damaged pipe and discrepancy in materials.

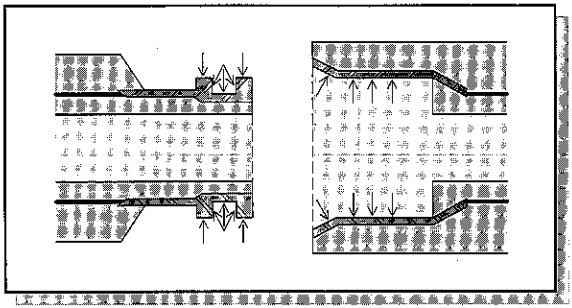
BEDDING PREPARATION



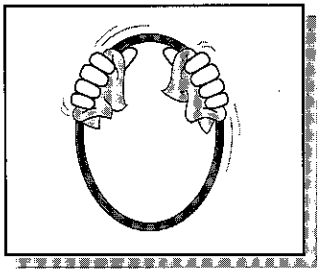
Prepare bedding as per project specifications. Once installed, pipe should lay evenly on the bedding along its entire length.

A space along the pipe width of approximately 8 in. deep by 16 in. long should be made where the joint will be located. A space can be provided under the pipe at its center to remove the cable after installation.

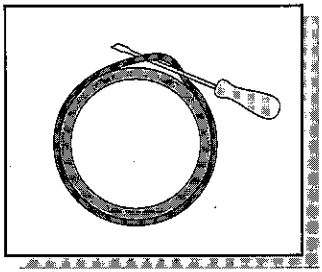
PIPE ENDS PREPARATION



The spigot groove and the inside surface of the bell must be clean and smooth. Remove any dirt, mud, sand, cement, etc. that could result in bad jointing. Apply lubricant generously in the spigot groove and on the inside surface of the bell.



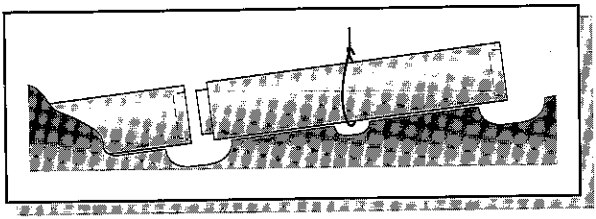
Before installing the rubber gasket into the spigot groove, apply lubricant on it using a cloth.



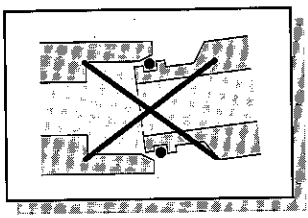
Install the gasket into the spigot groove. Stretch the gasket evenly by circling a screwdriver underneath the gasket along the whole circumference. Add lubricant.

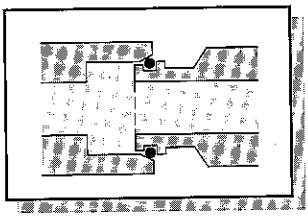
JOINTING

Position the spigot end towards the existing bell end.



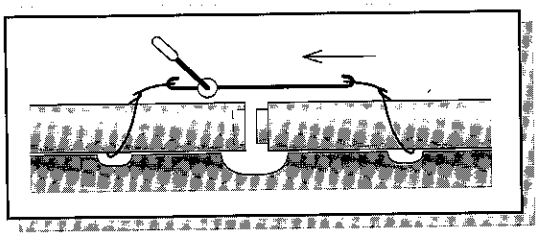
Lower the pipe into the trench,
making sure the trench bedding fits the proper slope.



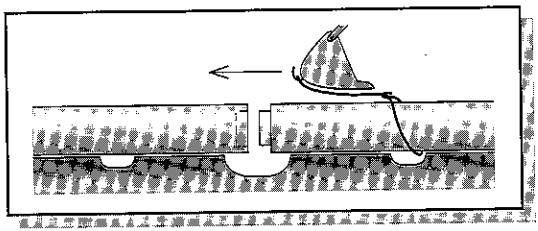


The gasket at the spigot end must
evenly touch the flare of the bell end.

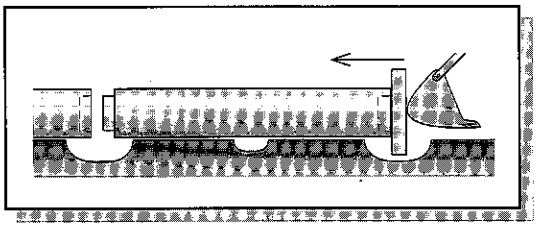
Pull or push to join both ends together.



Recommended
tool: a
"come-along".



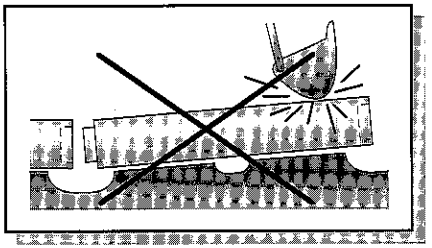
The lifting cable
and backhoe can
also be used,



or, using a large piece of timber at the bell end, gently push the pipe home using the bucket of the backhoe.

If the joint is not properly in place, remove the pipe and redo the joint using a new rubber gasket. An unusual sound during pipe jointing is frequently a sign of a pinched gasket.

Once installed, check the position of the gasket visually and with a feeler gauge.



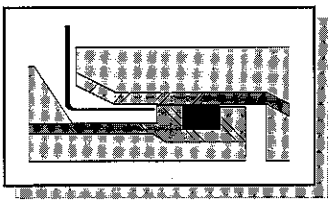
Never adjust pipe elevation by pressing or pounding on it!

USE OF A "FEELER GAUGE" FOR CHECKING GASKET INSTALLATION

The use of a feeler gauge is good indicator in determining if a joint is acceptable or not.

FOR ALL PIPES SIZES :

Use an external feeler gauge to check the gasket **from the outside.**

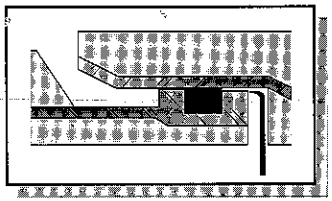


If you cannot feel the gasket anywhere along the circumference, the joint is ACCEPTABLE.

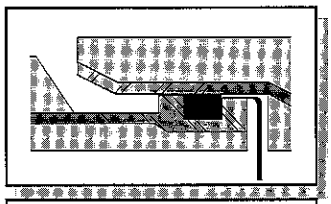
If you feel the gasket anywhere along the circumference, REMAKE the joint using a NEW gasket.

36 in. AND LARGER DIAMETER PIPE :
Standard Joints and All Restrained Joints

For these sizes of pipe, the inspection using the feeler gauge is to be done from the inside. Spacers (±.50 in.) inserted internally between the bell and spigot ends, must be used to permit the use of feeler gauges on pipes of these sizes.

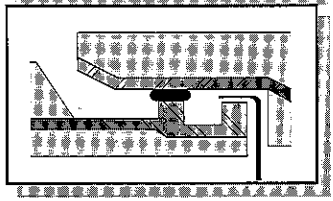


Feeler gauge does not fit between bell and spigot. Joint is ACCEPTABLE.



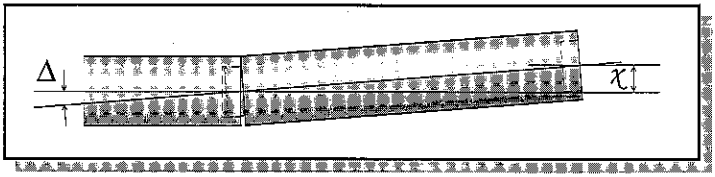
Occasionally, the joint rings may permit the feeler gauge to be inserted over the spigot lip for a certain distance along the circumference.

At these locations, you must be able to feel the gasket. If you do, the joint is ACCEPTABLE.



If you DON'T feel the gasket where the feeler gauge was inserted, this indicates that the gasket has been rolled or is cut. REMAKE the joint using a NEW gasket.

BELL AND SPIGOT JOINT DEFLECTION

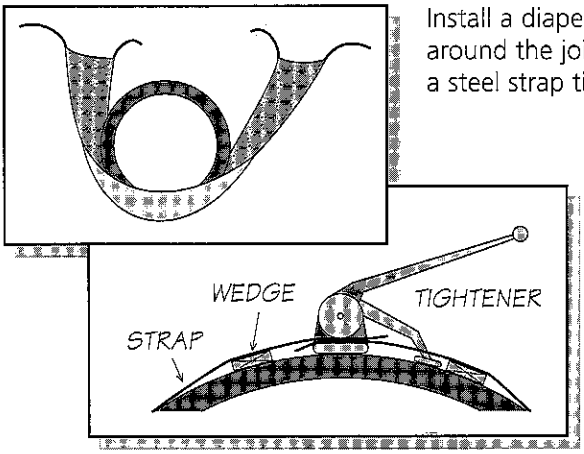


After the joint is in place,
the pipe can be deflected within the tolerable limits.

DEFLECTION CHART

Type of Pipe	Nominal Pipe Diameter in.	Maximum Joint Opening in.	Deflection Angle (Δ) deg.	Offset (x) ft. Pipe Length 20 ft.	24 ft.
C303	14	.50	1°-51′		.78
	16	.50	1°-38′		.69
	18	.63	1°-46′		.75
	20	.63	1°-37′		.68
C301 (L)	24	.67	1°-23′		.58
	30	.67	1°-07′		.46
	36	.67	0°-56′		.39
	42	.87	1°-03′		.44
	48	.87	0°-55′		.38
	54	1.02	0°-58′		.40
C301 (E)	60	1.06	0°-57′	.33	
	66	1.18	0°-57′	.33	
	72	1.18	0°-53′	.31	
	78	1.18	0°-49′	.29	
	84	1.26	0°-48′	.28	
	90	1.26	0°-45′	.26	
	96	1.26	0°-42′	.24	
	102	1.26	0°-40′	.23	
	108	1.61	0°-49′	.28	

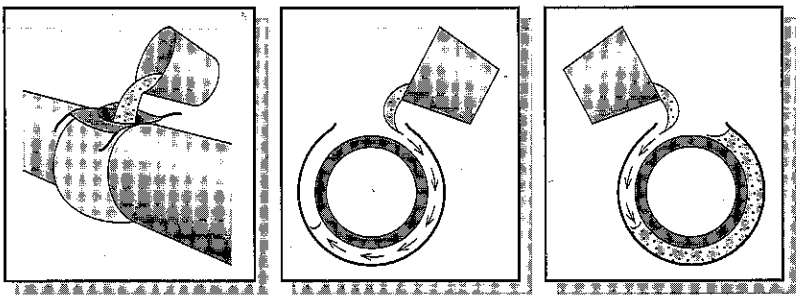
JOINT PROTECTION



Install a diaper around the joint using a steel strap tightener.

Place spacers between the strap and the pipe near the tightener in order to remove it without releasing the tension.
Use an appropriate crimping tool to lock the seal.

NOTE:
Small diameter diapers (20 in. and less) are supplied with steel wires to be twisted instead of straps as indicated above.

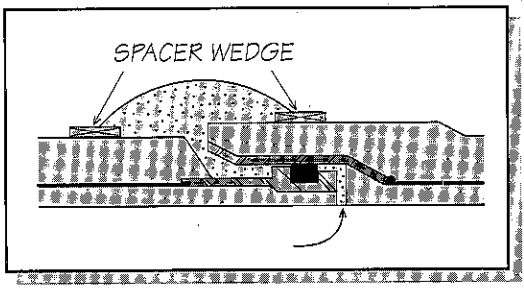


Pour on one side until the mortar appears on the other side.
Then complete the filling by pouring in the other side.
Make certain that the diaper is filled with the cement mortar.

Recommended mix for cement mortar:

1- cement
2- **clean** sand
+ **clean** water

It must be evenly mixed and liquid enough to fill the joint.



If required, the inside gap can be concreted using a mix of:

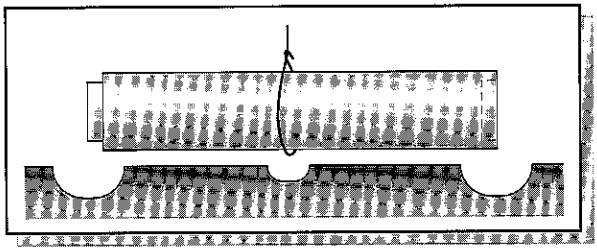
1- cement
2- **clean** sand
+ **clean** water

to obtain a mix that can be easily troweled.

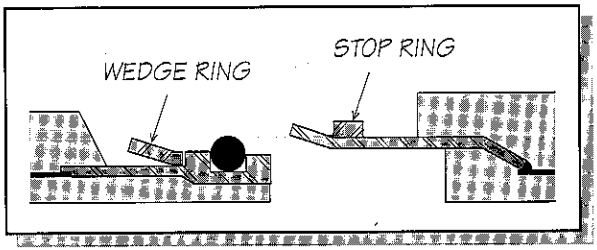
Complete the backfilling as per project specifications.

HOLDFAST RESTRAINED JOINTS INSTALLATION PROCEDURE

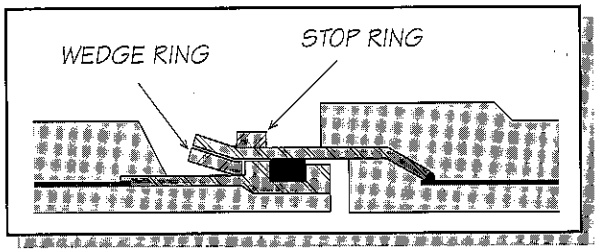
Hyprescon pipes with Holdfast restrained joints are installed in the same way standard pipes are. (See installation procedure).



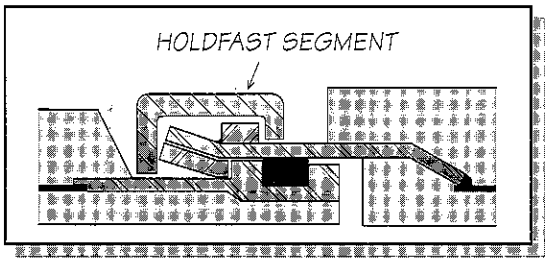
A space along the pipe width of approximately 8 in. deep by 16 in. long should be made where the joint will be located. A space can be provided at the center of the pipe to remove the lifting cable after installation.



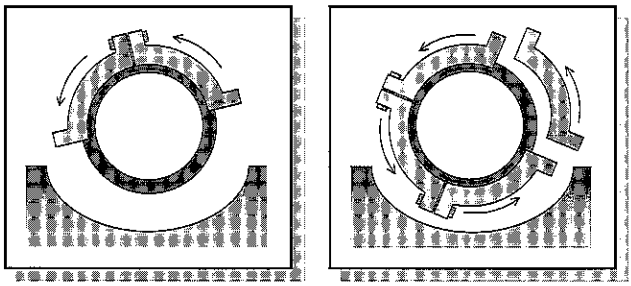
After the pipe is in place, it must remain aligned to install the Holdfast coupling.



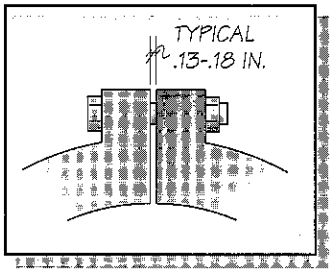
Ensure that the spigot wedge ring slides under the bell flare. The wedge ring should rest against the spigot shoulder and should be flush with the bell flare around the entire circumference.



Mount one Holdfast segment on the joint and check that it engages both the bell stop ring and the spigot wedge ring.

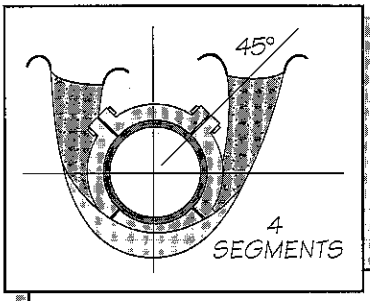


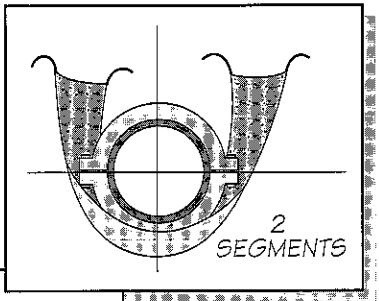
Slide the Holdfast segment around the joint and mount the next segment. Make sure the stop ring and wedge ring are well placed under the Holdfast coupling.

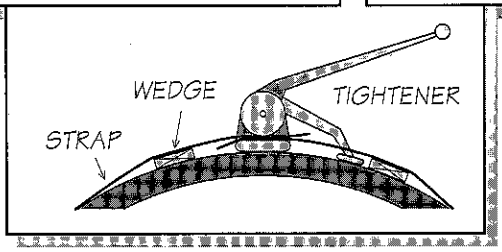


Equally tighten the connecting bolts. Check if the spaces between the segments are equal (maximum gap should be .13 - .18 in.) before tightening to 100 ft-lbs torque.

There should not be any measurable space between the outside diameter of the bell and the coupling.

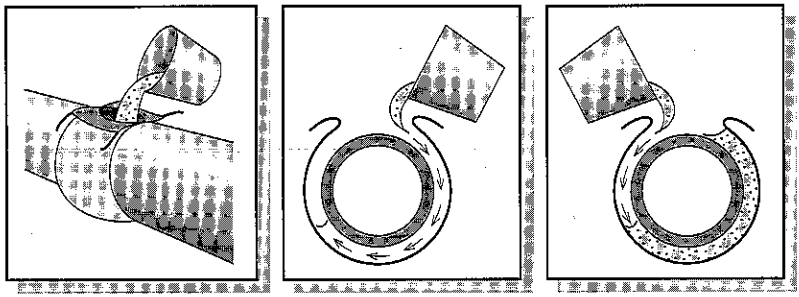




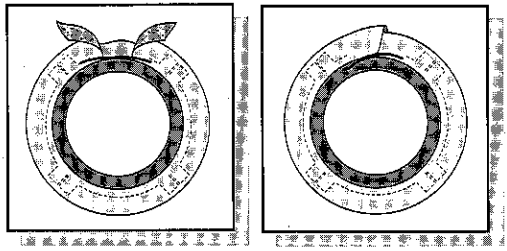


Install the flexible watertight diaper making sure the plastic surface is on the pipe side.

Use a steel strap tightener.
Place space wedges between the strap and the pipe near the tightener in order to remove it without releasing the tension.
Use an appropriate crimping tool to lock the seal.



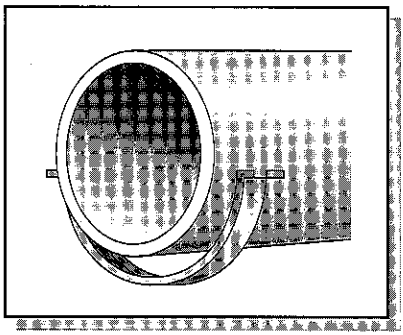
Place the grout directly on the joint between the plastic surface of the diaper and the pipe.



Close the top section of the diaper over the mortar.

60 in. TO 96 in. DIAMETER RESTRAINING COLLAR INSTALLATION PROCEDURE

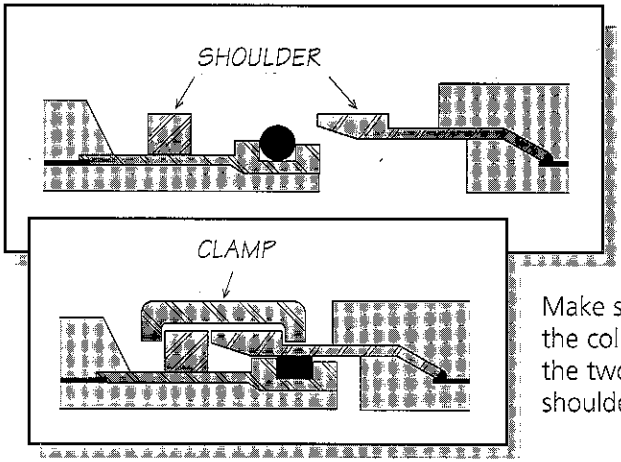
These collars come in two sections.



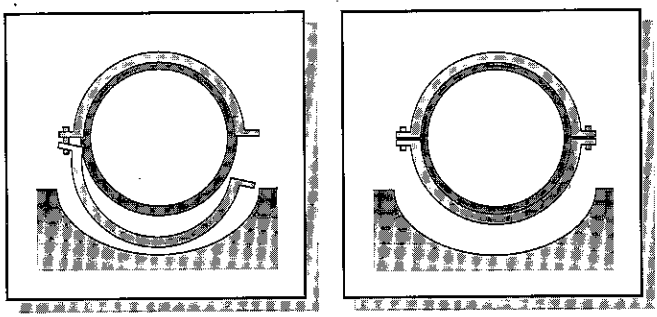
Before joining the pipe, place the bottom section of the collar underneath the already installed pipe.

Join the following pipe in the usual way.

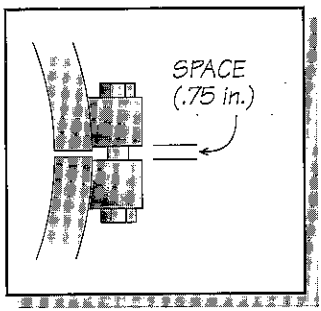
Place the top section of the collar on top of the joint.



Make sure the collar overlaps the two steel ring shoulders.

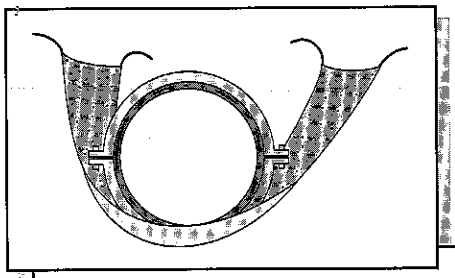


Lift one side of the bottom section of the collar and insert the bolts. Lift the other side and insert remaining bolts.

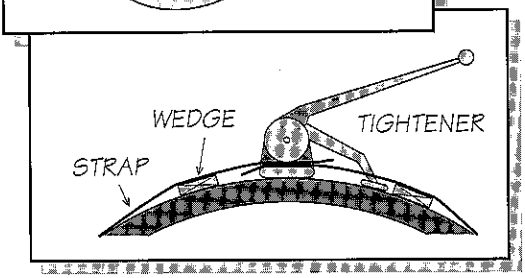


Tighten the bolts to 90 lbs-ft.
The space between the two collar section extremities is approximately .75 in.

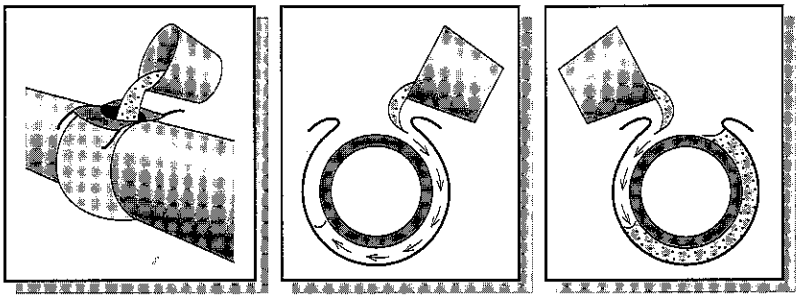
There should not be any measurable space between the outside diameter of the bell and the coupling.



Install the flexible watertight diaper making sure the plastic surface is on the pipe side.



Use a steel strap tightener.
Place space wedges between the strap and the pipe near the tightener in order to remove it without releasing the tension. Use an appropriate crimping tool to lock the seal.



Place the grout directly on the joint between the plastic surface of the diaper and the pipe. Refold the top part of the diaper over the grout. Besides obtaining corrosion protection, the cement mortar permits the loads to be evenly distributed in the joint.

Printed in Canada

Appendix F - Wastewater Health & Safety

Wastewater Treatment Plant
Occupational Health and Safety Bulletin

This bulletin is a guide to assist CUPE members in British Columbia ("BC") to understanding the risks of exposure in wastewater treatment plants, to minimize exposure to these risk factors and to provide information for prevention and compensation under WorkSafeBC.

Exposure to toxic substances, pathogens and other hazardous materials can have a significant long-term impact on workers and their families with many workers experiencing lifelong disabilities. There are also risks of injury to the head, feet, hearing including crush injuries, lacerations. This bulletin will primarily focus on exposure to chemicals and pathogens.

I. Introduction

Workers in the wastewater treatment sector are responsible for the day-to-day operation, maintenance, trouble-shooting and handling of special problems of municipal, industrial, and other wastewater treatment plants. Occupations can include Level 1 WWR (Wastewater) Plant Operator, Level 2 WWR Plant Operator, Senior Operator, Water Resources Specialist, Maintenance Operator, etc in both municipal and private facilities. Certification is set by the Applied Science Technologists and Technicians of BC (ASTTBC).

II. Injury Statistics

There is a lack of BC statistics for injuries and exposure in this sector. WorkSafeBC does not have statistics specific to this field, nor do many other jurisdictions within North America. In the United States ("U.S."), this sector contains both recycling and waste management, therefore, the injury and fatality rates are combined.

A 2009 U.S. Occupational Safety & Health Administration report put the incidence rate at 4.1 per 100 workers in the U.S. Slips and trips are the number one cause of injury (TPO, 2013). The most common physical injuries are strains and sprains to the back.

There is little information about the long-term effects of exposure to chemicals and pathogens. There is conflicting evidence regarding the development of cancer although pancreatic cancer appears to be higher in this sector[1]. Generally, there is a much higher rate of injury generally than other occupations (Spellman, 2013).

III. Who is Affected:

[1] Early studies from the European Union.

This sector includes workers involved with sewer inspection, maintenance work and sewage treatment plants operation. Most workers are male between 35 and 55 years of age. Workers may be employed in public or private facilities. Most workers are unionized in BC.

IV. What are the Hazards:

Workers in this sector are exposed to a variety of hazardous chemical and biological materials contained within the effluents and the reagents used in the water processing or generated during the water treatment.

Chemical agents may cause acute poisoning, chemical accidents (e.g., skin burns, injury to the eyes, etc.) damage to the respiratory system, allergies, dermatitis, chronic diseases, etc. Biological agents include pathogens such as bacteria, protozoa, viruses, helminths and fungi.

There may be injuries by slips, trips and falls on wet floors; by falls into treatment ponds, pits, clarifiers or vats and by splashes of hazardous liquids; they may suffer cuts and pricks from sharp tools, contusions, etc.

There is also exposure to hazards related to work in confined spaces (NIOSH, 2015).

Strains and sprains are the most common types of injuries.

The three primary types of exposure risks are:

1. **Biological**

   There is a high potential for illnesses arising from contact with viruses, bacteria and other microorganisms in sewage.

   The most serious viral risk is hepatitis. The most serious bacterial risk is tetanus.

   The main routes of exposure are hand-to-mouth contact. Breathing in a suspension of particles (aerosols) is a less common means of exposure but may occur whenever sewage is agitated or aerosolized. This occurs most commonly near incoming wastewater inlets and sludge treatment areas.

2. **Chemical**

   Confined spaces containing sewage can sometimes be deficient in oxygen due to organic oxidation and displacement by carbon dioxide. They can also contain flammable gases such as methane and toxic gases such as carbon monoxide and hydrogen sulphide. Carbon monoxide, carbon dioxide, and other exhaust gases may sometimes be present due to a poorly located gasoline engine or generator exhausting into the confined space. Chloroform is a common byproduct of disinfection.

3. **Metals**

   As per Brown (1997), metals are generally not air-stripped into the air in sufficient quantities to be significant (with the exception of mercury). Therefore, they accumulate either in sludge or pass through into the receiving water. Other possible hazards include asbestos and radioactive materials from medical facilities.

The five main categories of pathogens are:

- Bacteria
- Viruses
- Protozoa
- Helminths (parasitic worms) (CDC, 2002)
- Fungi (CDC, 2002)

Treatment processes do not eliminate the risk of exposure. As per Brown (1997), the primary treatment process may remove 80 - 90% of Salmonella; 50% of Mycobacterium; and coliform removal varies from 27 - 96%. The secondary treatment process removes from 50 - 90% of these pathogens. Activated sludge has a low removal rate of 85 - 99% for pathogenic bacteria. Waste solids do contain surviving pathogens. Anaerobic digestion appears to reduce pathogens by 74% to 97% (Brown, 1997; CDC, 2002). Tuberculosis, roundworms and certain enteric viruses appear highly resistant to treatment processes.

The two primary routes of pathogen and chemical contact are:

1. **Inhalation**

   This is the most common route for chemicals or pathogens to enter the body, usually via:

   - air-stripping from wastewater
   - bubble aeration
   - workers working near weirs, outfall and aerated tanks
   - dewatering processes
   - drying, compacting, incineration
   - exposure to chemicals while removing debris from treatment plant equipment (Brown, 1997)

   The affected areas of the body initially include the nose, throat and upper respiratory tract. Secondary areas are the eyes and lower respiratory tract (Brown, 1997).

   "Gas eye" due to hydrogen sulfide exposure is common[2] in this sector.

[2] Conjunctival and corneal tissue inflammation.

The most common specific pathogen exposures include (Lamfers, 2012; Brown, 1997):

- Fecal streptococcus
- Mycobacterium tuberculosis
- Gastroenteritis Enteroviruses (67 types), Rotaviruses, ("24-hour flu")
- Infectious Hepatitis
- Serum Hepatitis
- Aseptic Meningitis
- Adenoviruses (31 types), Reoviruses, Coronavirus
- Poliomyelitis
- Salmonellosis, Typhoid Fever
- Shigellosis
- Gastroenteritis (Escherichia coli)
- Amoebic Dysentery, Ameobiasis
- Giardiasis
- Meningoencephalitis
- Balantidiasis
- Parasitic worms (roundworms, hook worms, tapeworms)
- Fungi
- Allergic asthma caused by exposure to sewer flies

2. Skin Contact

This is a route of entry for both chemicals and pathogens. This includes being splashed in the mouth or on the skin. Chemicals can be absorbed through the skin from contact with wastewater or sludge. Disease organisms can enter the body through cuts, abrasions or needle sticks such as when removing screenings from a bar screen (Brown, 1997).

V. Worker Education:

Education about personal hygiene and safe work practices is extremely important to minimize contact with sewage and to prevent illnesses. While the employer bears the primary responsibility, everyone in the workplace needs to exercise caution.

Pre-planning, careful attention to personal hygiene and proper use of personal protective equipment (PPE) can greatly reduce the associated risks of exposure to sewage. It is essential that information be provided to the worker on reducing the risks of exposure and injury. Examples of worker practices include the following:

- Avoid direct contact with sewage.

- Avoid aerosolizing sewage water or minimizing exposure time in areas where aerosolizing is occurring. Make sure ventilation systems are functioning properly when working around areas where sewage may be aerosolized.

- Thoroughly cleanse all exposed injuries with soap and water and keep them covered with a bandage (preferably waterproof) while at work. Seek medication attention immediately after suffering cuts or penetrating injuries.

- If a worker is suffering from a skin problem, they should see a physician before working with sewage.

- Avoid touching the face, mouth, hands, eyes or nose with dirty hands or other items and avoid nail biting.

- Thoroughly wash the hands and face with soap and water before eating, drinking or smoking.

- Eat/smoke in designated areas away from sewage contamination. These areas must be kept free from contamination by leaving any protective clothing and boots in a separate area, for example.

- Use appropriate protective clothing at work (coveralls) and personal protective equipment (boots, gloves, plastic face shields) and, where required wearing respiratory protective equipment.

- Remove personal protective clothing and footwear at the end of the shift and leave it at work.

- Shower and change out of work clothes before leaving work.

- Report damaged equipment.

- Report all work-related symptoms to the employer and the physician. These may include:

    i. cramping stomach pains, diarrhea, vomiting
    ii. yellowing of the skin
    iii. symptoms of breathlessness, chest tightness and wheezing
    iv. redness and pain of the eyes
    v. skin rash and/or pain

    Tests for disease exposure can include:

        i. skin tests for tuberculosis and fungal infections
        ii. liver function tests for hepatitis

iii. white blood cell (leukocyte) counts
iv. urinalysis for fibrinogen degradation product (FDP) concentration

Workers with these symptoms should see a physician. Make sure that the physician is aware of conditions of work and potential exposures.

VI. Employer Responsibilities Including Implementation of Control Measures

What do the WorkSafeBC Act, Regulations and Policy say about air quality and hazardous substances exposure?

A. Applicable RSIM II Policy items include #12.00, #25.10, #26.10, #26.22, and #29.10 as well as RSCM I Policy items from the pre-2002 / 2003 changes in legislation and RSCM I Policy where exposure occurred prior to 2002 / 2003.

B. Applicable BC WorkSafeBC OHS Regulations[3] include:

- Section 3.10, which states in part that:

  Whenever a person observes what appears to be an unsafe or harmful condition or act the person must report it as soon as possible to a supervisor or to the employer, and the person receiving the report must investigate the reported unsafe condition or act and must ensure that any necessary corrective action is taken without delay.

- Part 3, Division 3 - General Duties of Employers, Workers and Others
- Part 3, Rights and Responsibilities
- Part 3, Section 4.13 – Risk Assessment
- Part 3, Section 4.14 – Emergency Procedures
- Part 3, Section 4.16 – Training
- Part 4 - General Conditions
- Part 4 - Working Alone or In Isolation
- Part 4, Section 4.44 – Entrapment
- Part 4 - Occupational Environment Regulations
- Part 4 - Indoor Air Quality
- Part 5 - Chemical Agents and Biological Agents - Chemical Agents and Biological Agents - Definitions, Designation as Hazardous Substances, and General Information Requirement

  An important section of Part 5 states that:

  "5.2 General information requirement

[3] Regulations and Policy are subject to frequent annual changes. Check with WorkSafeBC regularly.

If a worker is or may be exposed to a chemical agent, or biological agent designated as a hazardous substance in section 5.1.1, which could cause an adverse health effect, the employer must ensure that

(a) the identity of the chemical agent or biological agent, its possible effects on worker health and safety and any precautions required to protect the health and safety of the worker are clearly indicated by labels, SDSs, or other similar means,

(b) the information required by paragraph (a) is clearly communicated to the worker,

(c) written procedures are prepared and implemented to eliminate or minimize a risk of exposure to a chemical agent or biological agent by any route that could cause an adverse health effect, and to address emergency and cleanup procedures in the event of a spill or release of a chemical agent or biological agent, and

(d) the supervisor and the worker are trained in and follow the measures required in this Part and Part 6 of this Regulation for the safe handling, use, storage and disposal of the chemical agent or biological agent, including emergency and spill cleanup procedures.
[Amended by B.C. Reg. 319/2007, effective February 1, 2008.]
[Amended by B.C. Reg. 30/2015, effective August 4, 2015.]"

- Part 6 – Biological Agents
- Part 7 – Noise, Vibration, Radiation and Temperature
- Part – Toxic Process Gases
- Part 8 – Personal Protective Clothing and Equipment
- Part 9 – Confined Spaces
- Part 12 – Tools, Machinery and Equipment
- Part 13 – Ladders, Scaffolds and Temporary Platforms
- Part 32 – Evacuation and Rescue

What specific actions should employers take? These include the following (CDC, 2002; EPA, 2015):

- Conduct Safety Tailboard sessions at the beginning of each shift.

- Conduct a Risk Assessment. This is a critical part of ensuring a safe work place and identifying risks. See Figure 1 as an example of follow-up.

- An employer must provide first aid services, supplies and equipment and provide a first aid room as per the applicable requirements of OHS legislation.

- Since pathogens are a natural part of sewage, the hazard cannot be eliminated. A site-specific assessment of the risk of worker's exposure to the hazards of sewage must be completed.

- Improve engineering controls such as ventilation.

- Ensure that workers and management (and supervisors) understand risks through education on hazards, the importance of following safe work practices and the importance of hygiene measures. Regular industry training may also be required per the industry association and legislation.

- Ensure workers use appropriate PPE such as liquid-repellant coveralls and gloves, boots, goggles, respirators, and splash-proof eye/face shields. If respirators are needed, a comprehensive program must include respirator fit testing and a respirator code of practice.

- Label piping.

- Cover the primary clarifier weir area.

- Ensure workers remove contaminated clothing after completion of a job (Lamfers, 2012).

- Ensure workers shower at work and change into clean clothes (Lamfers, 2012).

- Establish a proper system for purchase, inspection and maintenance of PPE.

- Ensure areas for storage of clean and contaminated equipment and personal effects are segregated and separate from eating facilities, and have facilities readily available for decontamination of workers.

- Develop and implement policies and procedures for post-exposure management of workers exposed to bio hazardous material.

- Where feasible, substituting Class A biosolids could reduce the pathogen exposure risks during land application compared to applying Class B biosolids.

- Monitor the source material coming from the wastewater treatment facility.

- Check monitoring results to assure they meet specified Class B or Class A standards prior to land application operations.

- Monitor stored biosolids prior to application to assure that the biosolids are properly stabilized and that unacceptable re-growth or cross-contamination from sub-standard material has not occurred.

- Where local conditions permit, inject biosolids below the soil, or incorporate (thoroughly mix) into tilled soil.

- On windy days, avoid spreading or disturbing dry biosolids (e.g., compost) that would create dust.

- On windy days, avoid spreading biosolids by high-pressure spray to limit aerosolization.

- Avoid unnecessary mechanical disturbance and contact with land-applied Class B biosolids during the period when public access is restricted.

- Equip heavy equipment used at storage and application facilities with sealed positive pressure, air-conditioned cabs that contain filtered air recirculation units.

- Monitor worker exposures when adjusting precautions to address site-specific issues.

- Consider suppressing the droplets just above the surface by using:

  - single layer screen - 100-200mesh
  - multiple layer or knitted mesh screen
  - fiber beds
  - foam or granular bed
  - flat plate or slats over the tank
  - water spray to beat down the wastewater droplets
  - rotating brush

- Consider collecting the droplets by:

  - sedimentation
  - multiple cyclone
  - scrubber
  - electrostatic precipitator
  - fabric filtration (Brown, 1997)

VII. Basic Hygiene for Workers (CDC, 2002)

In addition to the safety precautions for workers and employer, there are basic hygiene practices that can reduce the likelihood of exposure and injury. These include:

- Wash hands thoroughly with soap and water after contact with biosolids.

- Avoid touching face, mouth, eyes, nose, genitalia, or open sores and cuts while working with biosolids.

- Wash hands before eating, drinking, smoking, and before and after using the bathroom.
- Eat in designated areas away from biosolids handling activities.
- Do not smoke while working with biosolids.
- Use barriers between skin and surfaces exposed to biosolids.
- Remove excess biosolids from footgear prior to entering a vehicle or a building.
- Keep wounds covered with clean, dry bandages.
- Flush eyes thoroughly, but gently, if biosolids contact eyes.
- Change into clean work clothing on a daily basis and reserve footgear for use at work site or during biosolids transport.
- Do not wear work clothes home or outside the work environment. Use gloves to prevent skin abrasion.

VIII. Conclusion:

Unionized workers enjoy more effective enforcement of legislated labor protections such as safety, health, and overtime regulations (Mishel and Walters, 2003; Zullo, 2012; Frazis, Gittleman, et al. 1995). This is important in sectors with high injury rates such as wastewater treatment. Employers and workers should update safety practices, procedures and education on a regular basis. CUPE has developed many Guides, templates and forms for numerous aspects of prevention and compensation. See the CUPE BC OH&S website at http://www.cupe.bc.ca/committees/occupational-health-and-safety for many of these. These are updated frequently, so ensure these are current.

IX. Further Information and Sources

Accidents and Injuries in the Waste Management Sector
http://oshwiki.eu/wiki/Accidents_and_injuries_in_the_waste_management_sector

Alberta Water & Wastewater Operators Association. https://awwoa.ab.ca/

American Waterworks Association. http://www.awwa.org/

Atlantic Water & Waste Water Association. http://www.acwwa.ca/

ACWWA Library. Safety series. http://www.acwwa.ca/library/libraryvideos.html

Ahrens, M. (2012). Worker Casualties involving Wastewater, Sewers or Sewage Treatment Plants and Fire Incidents at Water or Sanitation Utilities. https://www.nfpa.org/Assets/files/AboutTheCodes/820/1855%20-%20Wastewater_Sewers_or_Sewage_Treatment.pdf

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Brown, H.J. (1997). Health Hazard Manual: Wastewater Treatment Plant and Sewer Workers. Cornell University ILR School.

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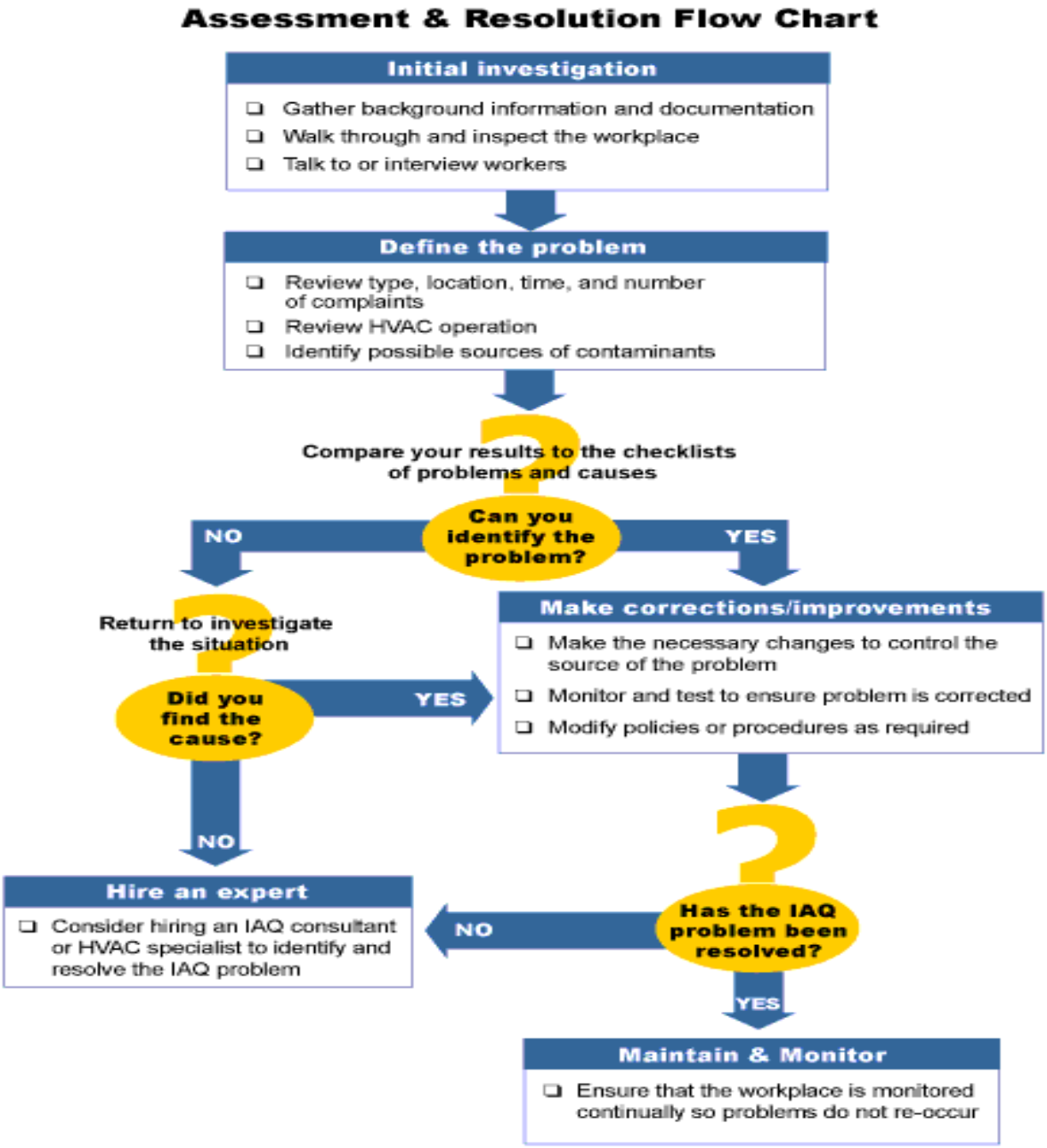
X. Figures

Figure 1: Sample Air Quality Investigation Process



Appendix G - Extending Pump Station Shut-Down Periods

As noted in Section 4.2.2.4, the CVRD has noted that the Courtenay and Jane Street Pump Stations can each be shut down for approximately 20 minutes at peak flow (9 a.m. to 7 p.m.), and for 40 minutes at low flow (3 a.m. to 4 a.m.); these are very short windows and, thus, it will likely be necessary to implement measures that will extend these shut-down periods.

This appendix contains information on things that the CVRD could attempt to carry out to increase the allowable shut-down periods for the two pump stations. This appendix should be updated regularly by the CVRD to account for initiatives that have been, or could be, carried out.

The CVRD has indicated that the Courtenay Pump Station's low flows range between 180 to 200 m^3/hr and the high flows range between 500 to 600 m^3/hr. The CVRD has also indicated that it is difficult to determine the Jane Street Pump Station's flows accurately, as there is no flow meter on the influent side; however, some flow metering was reportedly carried out in 2012 along with calculations on pump cycles, and the CVRD estimates the low flows range between 75 to 100 m^3/hr and the high flows range between 325 to 375 m^3/hr.

Suggestions for things that the CVRD could attempt to carry out to increase the allowable shut-down periods for the two pump stations are presented below, along with comments that highlight some of the issues; as already mentioned, this appendix should be updated by the CVRD to reflect any progress on these or other initiatives.

- Temporarily isolating sections of the sewer system upstream from the Courtenay and Jane Street Pump Stations. While this could delay an overflow at the pump stations, it will eventually create an overflow and/or flooding elsewhere.
- Using pumper trucks to pump out of the wet wells of the Courtenay and Jane Street Pump Stations and truck wastewater to the CVWPCC. With pumper truck capacities likely ranging between 6 and 10 m^3, and with a limited number of local pumper trucks, this initiative will not be feasible due to the volumes of wastewater that will need to be pumped and transported, unless other initiatives manage to significantly reduce the wastewater entering the pump stations. This initiative would be more feasible if permanent piping is installed at the pump stations to facilitate the use of pumper trucks.
- Temporarily shutting off the water supply to the Courtenay and Jane Street Pump Station service areas. The distribution system could be shut down, but it would be full of water and could take a long time to drain (thereby delaying the benefit of this initiative); furthermore, the CVRD has indicated that, once the water system is de-pressurized, it would have to be classified as potentially

contaminated (especially if there is sewer backing up) and a full system disinfection process would need to be undertaken.

- An emergency communications campaign could be developed, possibly making use of the CVRD's new Connect Rocket automatic email and text system, to appeal to Courtenay and Comox residents to not flush their toilets, shower or do laundry.
- Overflow tank(s) or pond(s) could be designed and constructed to receive excess wastewater during the shutdown of the pump stations.

Appendix H - Spill Response Checklist

Spill Response Checklist

Comox Valley Regional District

Task No.	ü	Initials	Date/time of completion	Description	Section No.
IDENTIFY INCIDENT					
1	☐			Fill out Environmental Incident form (Table 3-2).	4.1.1
NOTIFY					
2	☐			Notify CVRD personnel on Table 4-1.	4.1.2
3	☐			Notify appropriate organizations MoE, WorkSafeBC, Coast Guard, etc.	4.1.2
4	☐			Carry out Initial Spill Response Meeting includes assigning Incident Commander, reviewing the repair steps, delegating tasks, identifying required 3rd parties, etc.	4.1.2
5	☐			Carry out non-mandatory notifications (see Table 3-1).	4.1.2
6	☐			Contact 3rd party contractors and consultants (Table 4-2).	4.1.2
7	☐			If possible, attempt to contain and collect leaking wastewater.	4.1.2
EXCAVATE					
8	☐			Identify location of leak, if this has not already been done.	4.1.3
9	☐			Secure the site, implement traffic control plan, if required.	4.1.3
10	☐			Contact BC One Call (1-800-474-6886) prior to excavation.	4.1.3
11	☐			Expose damanged/leaking pipe.	4.1.3
ASSESS					
12	☐			Visit and assess spill site with key parties.	4.1.4
13	☐			Attempt to contain and collect leaking wastewater.	4.1.4
14	☐			Fill out Emergency Repair Questionnaire and distribute to appropriate parties.	4.1.4 / Appendix D
15	☐			Update Environmental Incident form (Table 3-2) & update the previously notified parties.	4.1.4
16	☐			Carry out Repair Planning Meeting with key parties to determine/document the Repair Methodology	4.1.4
REPAIR					
17	☐			Gather required crew, equipment, tools and materials to site.	4.2.2.1 to 4.2.2.3
18	☐			Shut down pump stations and lock out.	4.2.2.4 / Appendix G
19	☐			Close any isolation valves upstream and downstream of leak, if available.	4.2.2.4
20	☐			Initiate and complete repair or replacement.	4.2.2.4 / Appendix E
21	☐			Place clear crush or granular pipe bedding.	4.2.2.4
22	☐			Open previously closed valves upstream and downstream of leak.	4.2.2.4
23	☐			Bring the pump stations and force mains back into service.	4.2.2.4
24	☐			Conduct visual inspection to confirm repair was successful and no additional leaks are present.	4.2.2.4
25	☐			Backfill and restore ground surface to original condition.	4.2.2.4
26	☐			Demobilize.	4.2.2.4

Spill Response Checklist

Comox Valley Regional District

Task No.	Ü	Initials	Date/time of completion	Description	Section No.
CLOSE-OUT					
27	☐			Notify parties notified earlier that the leak has been contained and repaired.	4.3.1
28	☐			Follow any recommendations from organizations contacted prior to repair.	4.3.1
29	☐			Reorder and relabel any materials used, and return to designated storage area.	4.3.2
30	☐			Temporarily update inventory table, noting items on order.	4.3.3
31	☐			Reinstate original inventory table once new materials have been relabelled and stored.	4.3.3